COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

July, 1948

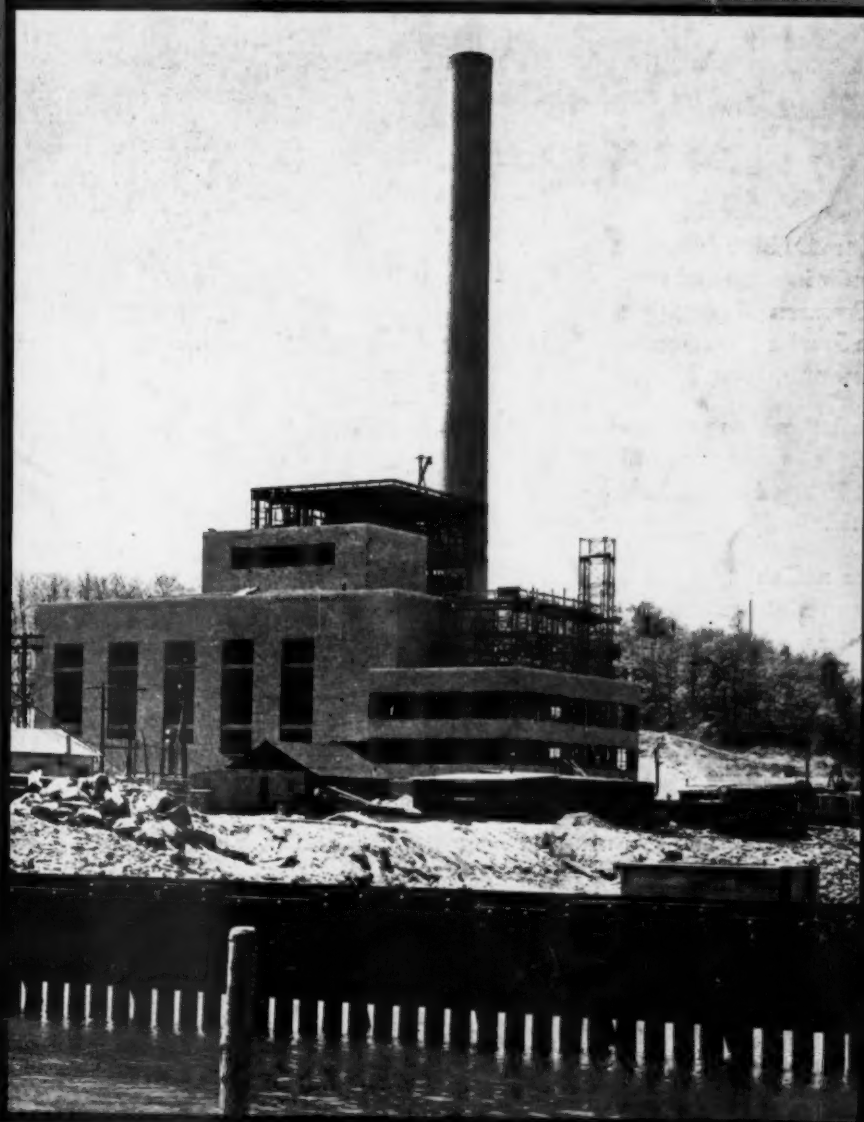

Photo by H. R. Towes
Port Jefferson Station of Long Island Lighting Company nears completion

What's New in Boiler Feed Pumps?

Prevention of Turbine-Blade Deposits

Checking Water Level in Boiler Drums

Recent C-E Steam Generating Units for Utilities

SEWAREN GENERATING STATION

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

THE C-E Unit illustrated here is one of three such units now in course of construction at the Sewaren Generating Station of the Public Service Electric and Gas Company at Sewaren, New Jersey.

Each of these units is designed to produce at maximum continuous capacity 850,000 lb of steam per hr at 1500 psi and 1050 F at the turbine throttle.

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These will be the first power station units to employ a steam temperature above 1000 F.

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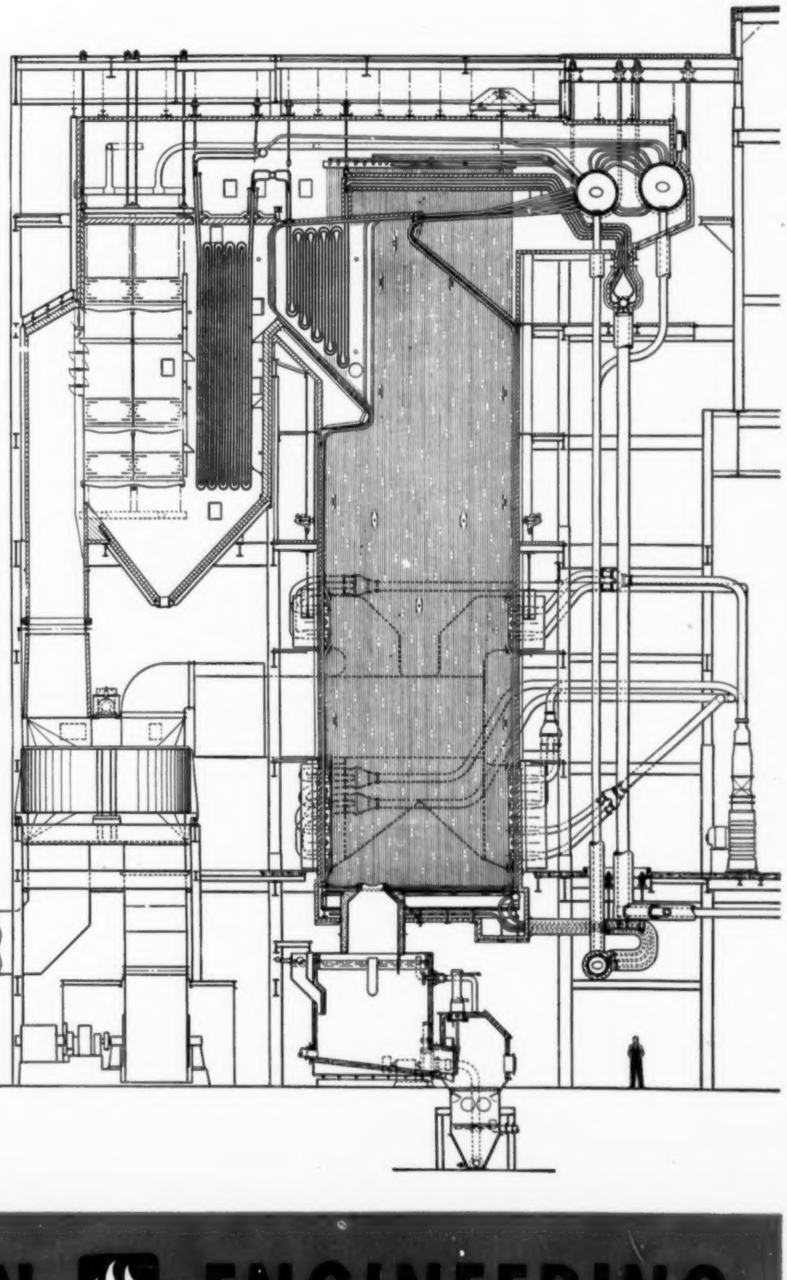

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COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

VOLUME TWENTY NUMBER ONE

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FOR JULY 1948

FEATURE ARTICLES

EDITORIALS

DEPARTMENTS

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Published monthly by COMBUSTION PUBLISHING COMPANY, INC., 200 Madison Ave., New York 16
A SUBSIDIARY OF COMBUSTION ENGINEERING COMPANY, INC.

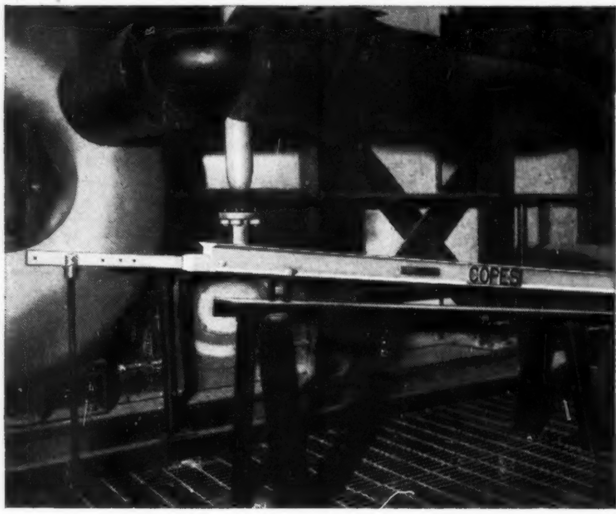
Frederic A. Schaff, President; Charles McDonough, Vice-President; H. H. Berry, Secretary and Treasurer.

COMBUSTION is sent gratis to engineers in the U. S. A. in charge of steam plants from 500 rated boiler horsepower up and to consulting engineers in this field. To others the subscription rate, including postage, is $3 in the United States, $3.50 in Canada and Latin America and $4 in other countries. Single copies: 30 cents.

Issued the middle of the month of publication.

Publication office, 200 Madison Ave., New York CCA Member of the Controlled Circulation Audit, Inc.

Printed in U. S. A.



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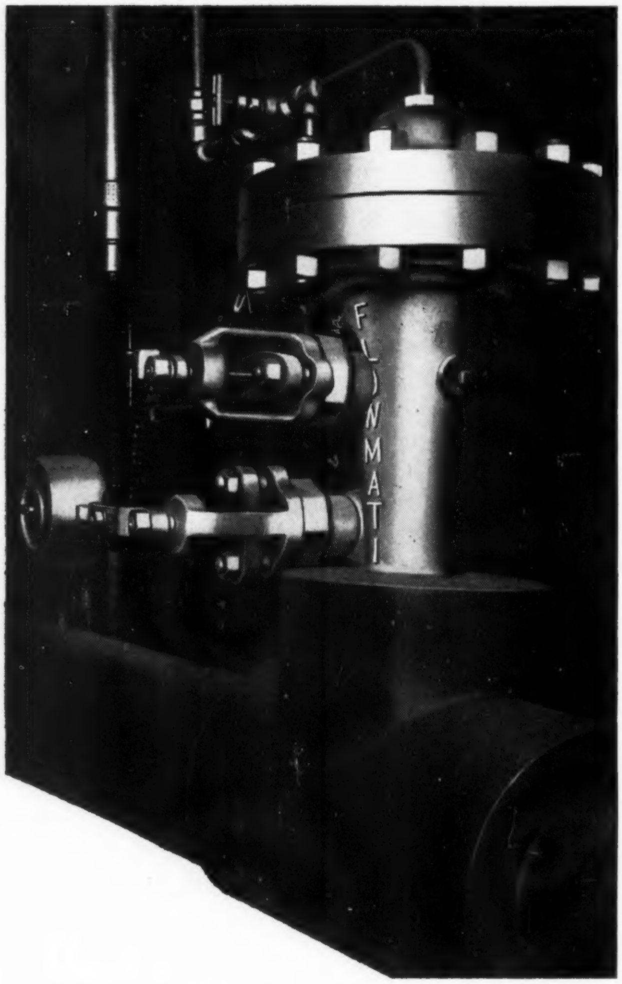

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EDITORIAL

Without Feedwater Treatment

Twenty-two years of trouble-free experience in a large number of plants of the Commonwealth & Southern System without employing feedwater treatment, as related by Mr. Daniels, may lead one to question the necessity of treatment as usually practiced. The subject has long been a controversial one, with Mr. Daniels' experience backed by that of at least one other large power system; yet in the majority of plants it seems to have been found desirable to go in for both feedwater conditioning and treatment of boiler water. Despite such precautions, turbine-blade deposits are still prevalent and make it necessary to resort to steam and hot water washing for removal of soluble deposits in the high-pressure stages and either sandblasting or caustic washing for removal of silica deposits in the low-pressure section.

Of course, it must be remembered that the plants of the Commonwealth & Southern System have thus far employed moderate steam pressures and temperatures—400 and 900 psi, and not exceeding 900 F; and in general, experience shows that silica deposits have rarely occurred at 400 psi; that they increase with pressure and may become acute above 900 psi. Nevertheless, the simplicity of Mr. Daniels' procedure, involving only condenser deaeration, evaporated makeup, very small blowdown and relatively low pH, is most intriguing.

Lewis Marches On

Undaunted by injunctions and fines, and despite the liberal allowances already in effect and the relatively high income of the miners, John L. Lewis has again emerged triumphant in having practically all his latest demands met by the coal operators. These included a wage increase of a dollar a day and doubling of the payments into the welfare fund, as the price of averting a nation-wide coal strike, when the present contract expired on June 30. Such surrender would appear as a travesty on "collective bargaining."

Presumably, the very substantial increase will again be passed on to the coal consumer and, in turn, will be reflected in increased costs of those products into which coal enters as a basic raw material. It will also set a pattern for the price of competitive fuels.

The agreement extends for twelve months only and, judging from past performances, it is anticipated that a year hence Mr. Lewis will be back again with further demands to boost the inflation spiral.

In the field of power generation, where fuel is a major item, advances in equipment design and operating practice have heretofore gone far to offset ever-increasing fuel costs. Had this not been so, the cost of power today would have been such as to restrict its use and we would not have had the phenomenal growth that has distinguished this country's widespread use of electricity. However, the law of diminishing returns now makes it more difficult for engineers to offset appreciably advancing coal costs and the net result must be higher generating costs — until perhaps such time as nuclear energy becomes a competitor of coal.

Outlook for Power Equipment

The National Security Resources Board has released the results of a recent study of scheduled deliveries and productive capacity among the twelve leading manufacturers of major power equipment. The results are enlightening in view of various comments and predictions that have emanated from uninformed sources.

Except for some scarcity in certain thicknesses of plate, the boiler situation appears generally satisfactory and well able to keep abreast of turbine-generator shipments. With units aggregating seventy million pounds of steam per hour scheduled for delivery during the last eight months of this year, and a capacity of forty-four million for delivery in 1949, the present backlog will be mostly completed by the middle of next year, leaving an additional productive capacity of sixty million pounds of steam per hour that can be taken on for construction during 1949, providing the plate situation does not become more acute.

Large steam turbine-generators, however, are not in as favorable a position. Present orders cover manufacturing capacity through the early part of 1951, although orders for small turbine-generators can still be placed for delivery in 1949. In fact, there is a large available capacity for turning out units of 10,000 kilowatts and less—a fact that should be of interest to some industrial plants.

The waterwheel situation is reported satisfactory with deliveries of 18 to 24 months, according to the amount of engineering involved.

The report points out that experienced engineers and designers are difficult to obtain and that competition for their services may be anticipated in the event of a rearmament program. This emphasizes the desirability of placing repeat orders for steam generating units where possible and following the A.I.E.E.-A.S.M.E. Preferred Standards as concern steam conditions and turbine-generator capacities, in order to minimize the engineering time involved.

On the whole, the findings appear reassuring, save for a few spots such as iron castings, valves, piping and certain plate, which may be aggravated by the captive mine strike.

WHAT'S NEW IN BOILER FEED PUMPS?

By L. J. DAWSON

Cameron Pump Div., Ingersoll-Rand Co.

For high-pressure stationary plant service, details are given of typical improved straight-through pumps as well as those of a re-entry type pump that is adaptable to varying conditions. New designs of high-pressure feed pumps and a special type of drain pump for marine service are discussed.

THE present expansion program of the power industry has created a renewed interest in boiler feed pump units. The standard "straight-through" pump has undergone mechanical evolution in the interests of better hydraulic performance, greater reliability and simplicity of maintenance. The re-entry feed pump has entered the picture and appears to be here to stay. In addition to stationary installations, recent progress in the marine power plant field has necessitated the development of new high-pressure, high-speed pumps.

Typical of the "straight-through" feed pumps are the four units being installed by the Long Island Lighting Company, two each at the Glenwood Landing and Port Jefferson generating stations. Conditions on these pumps are as follows:

Gallons per minute	1025
Total head, feet	3960
Temperature of water	278 F
Discharge pressure	1635 psi
Suction pressure	33 psi plus 30 ft

The units are driven by 1500-hp Westinghouse induction motors through American Blower Type VS variable-speed hydraulic couplings. At full load, coupling input is 1444 bhp at 3550 rpm, and the output is 1370 bhp at 3450 rpm. These units are equipped with Republic automatic bypass control to maintain a minimum flow of 215 gpm through the pumps.

Fig. 1 is a sectional elevation of one of these pumps, from which it will be noted that emphasis has been placed on simplicity of design. It has been proved by experience that a design with the minimum number of parts gives more trouble-free operation and is easier to maintain. Corrosion-resistant materials are used throughout for all parts in contact with moving liquid. Bearing linings are of the precision steel-backed automotive type

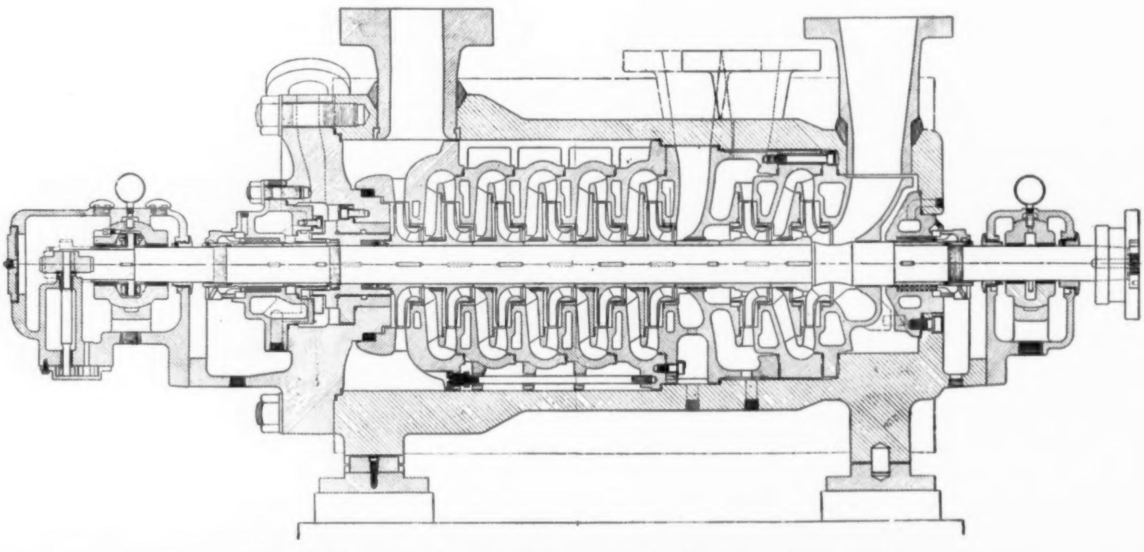


Fig. 1—Section of straight-through feed pump as provided for C. E. steam-generating units at Glenwood Landing and Port Jefferson Stations

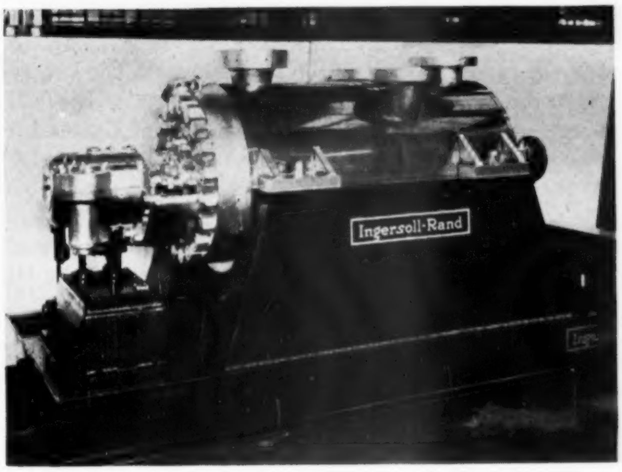


Fig. 2—Exterior view of 8-stage re-entry boiler feed pump for Walnut Station

with full force-feed lubrication. Labyrinth type flingers are employed to keep dirt out and oil in. A new type gland arrangement permits piping the gland quench water to the end of the stuffing box instead of to the gland proper, leaving the gland free of all attachments which would interfere with adjustment or repacking ease. A novel feature of the new quench arrangement is that leakage around the outside of the packing is quenched and conducted to the gland drain, thus eliminating a shortcoming of the standard quenching gland. By eliminating steaming at the gland, condensation in the bearings is greatly reduced.

Impellers are of one-piece construction. Field experience has shown that the virgin metal of the impeller hubs has excellent wearing qualities as a ring fit member. By eliminating impeller rings and rear bushing rings, the possibility of cracked or torn off rings during early station operation is avoided. It is during this early period of station operation that dirt and pipe scale pass through the pumps, and although foreign matter of this character will leave its mark on any running fit, a slight scoring of a solid hub is to be preferred to a cracked or loose separate ring. Enough metal is provided to install rings at a later date if wear should require restoring the original diameter. Solid hubs have operated over 40,000 hours to date with no appreciable evidence of wear.

The use of Flexitallic gaskets throughout provides positive sealing at all points of pressure differential without sacrificing ease of dismantling. In fact, the inherent spring action of this type of gasket actually cooperates in separating the members when bolt tension is removed. A novel use of such gaskets is the expansion compensator between the last stage channel ring and the discharge head. Here, a series of gaskets separated by stainless-steel washers provides the necessary flexibility to allow expansion movement between the rotor and shell. The simplicity of the arrangement is apparent and positive sealing is assured without resort to complicated expansion joints and bolting.

The Re-Entry Type Pump

Many modifications of the basic pump type shown in Fig. 1 are possible. Capacity and pressure ratings can be changed by varying size and number of stages. For high suction pressures, labyrinth leakoff stuffing boxes can be incorporated. An interesting modification is the re-entry pump furnished to the Columbus & Southern Ohio Electric Company's Walnut Station. The original units at this station were tandem type with a separate booster pump direct-connected to the high-pressure feed pump. After leaving the booster pump, the feedwater passed through three heaters and thence to the high-pressure pump suction. This resulted in 430 psi suction pressure on the secondary pump. When an additional unit was needed a re-entry pump was proposed and accepted. Fig. 2 is an exterior view of this unit and Fig. 3 a cross-section. Water at 190 F enters the primary section of the pump where it passes through two stages and discharges at 480 psi from the second nozzle. After passing through the heaters, the water re-enters the third nozzle at 430 psi and 400 F. Six stages in the secondary section boost the pressure to 1685 psi. Capacity at discharge conditions is 1280 gpm.

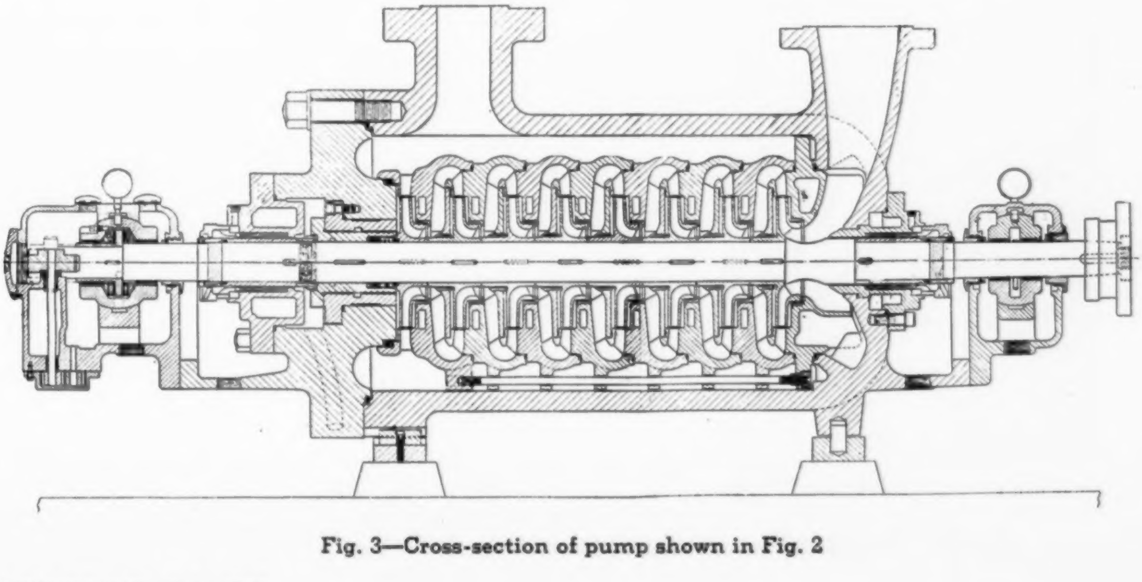


Fig. 3—Cross-section of pump shown in Fig. 2

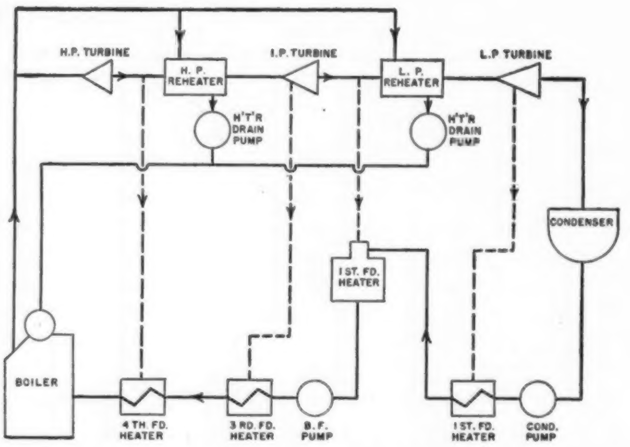


Fig. 4—Simplified flow diagram of high-pressure installation on ore ship

In order that the 400-F water leaving the balancing drum will not have to be degraded to 190-F suction temperature, the balancing drum leakoff is piped to the suction of the secondary section. The primary section impellers are provided with back hubs and balance holes so that they are self-balanced. To provide a reasonable stuffing box pressure on the high-pressure end of the unit, a labyrinth leakoff is employed. To aid the packing further, the 400-F water from the drum chamber is not broken down in the labyrinth, but instead 190-F water from the discharge of the primary section is introduced in the mid-point of the labyrinth. This 190-F water flows in both directions in the labyrinth—outward to a low-pressure leakoff and inward to the balancing drum leakoff chamber. The differential pressure causing inward flow is the result of the friction drop through the heaters between the primary and the secondary sections. Both stuffing boxes are packed against only 190 F and low pressure, and there are only two boxes as compared to four for the two-pump system.

For starting purposes, each section of the pump is equipped with a bypass. A jumper is provided between primary discharge and the secondary suction so that the unit may be started on 190-F water with the heaters bypassed. By closing the bypass the water is gradually shunted through the heaters and the secondary section is brought up to temperature.

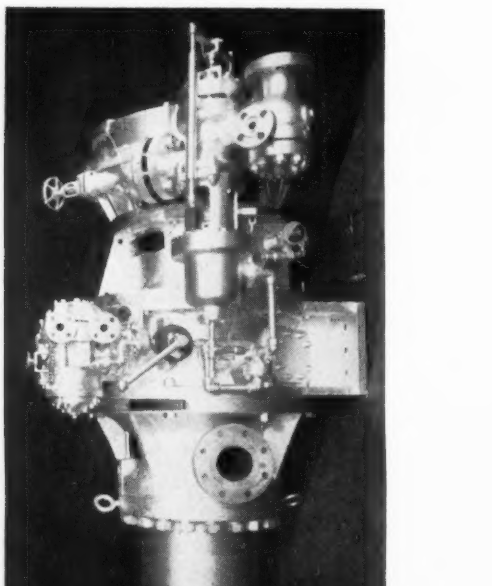


Fig. 5—Vertical high-speed boiler feed pump for ore ships

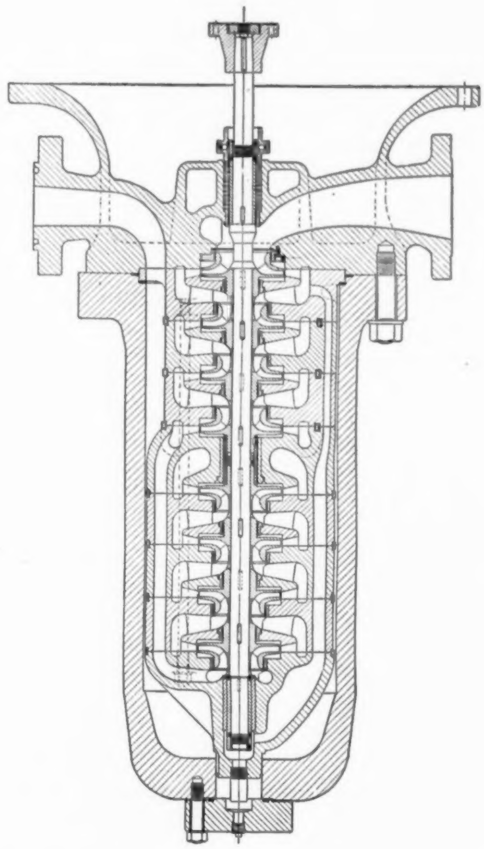


Fig. 6—Section through pump shown in Fig. 5

High-Pressure Marine Pumps

The trend to higher pressures in marine work has necessitated the development of new boiler feed pumps specially designed for maritime requirements. An outstanding example of recent high-pressure ships are the dry-bulk cargo vessels built by Bethlehem Steel Co., Shipbuilding Division, for Ore Steamship Company. These vessels are of 32,300 tons displacement when loaded and develop 11,000 shaft horsepower at 95 rpm of the screw and a speed of 16.4 knots. Steam pressure at the superheater outlet is 1450 psi at 750 F. Throttle conditions are 1410 psi and 740 F. Fig. 4 represents a simplified flow diagram of the cycle. Live steam reheat is employed between the high-pressure and the low-pressure turbines and also between the intermediate- and the low-pressure turbines. Four feedwater heaters

are used, the second heater being of the direct-contact deaerating type. It is from this heater that the boiler feed pumps take suction. Pump conditions are as follows:

Gallons per minute	200
Total head, feet	3900
Temperature	250 F
Discharge pressure	1630 psi
Suction pressure	30 psi
Rpm	6480

Drive is by General Electric type turbines with 1400 psi steam at the throttle. Fig. 5 is an exterior view of an assembled unit. The units are mounted directly on a transverse bulkhead in the hull, three per vessel. Fig. 6 shows the details of the pump. The shaft is supported vertically by the turbine through a solid coupling. Pump suction is at the top and the flow is downward through the first four stages. The stream is then conducted to the bottom of the unit where it passes upward through the remaining four impellers. The bottom steady bearing is internally lubricated and an adequate flow of water is assured by connecting the lower end back to first-stage discharge pressure, thus resulting in three stages of pressure difference across the bearing. The center internal bearing is located between stages 4 and 8 and is likewise assured of adequate lubrication by virtue of the pressure differential.

Discharge pressure exists in the space between the rotor assembly and the forged outer barrel, and this pressure acting on the end of the rotor assembly eliminates the need for heavy rotor through-bolts. Nominal bolting is provided to hold the assembly during non-operating periods and during assembly.

All contact parts are of corrosion resistant materials for resistance to high-purity feedwater. As in stationary practice, an effort has been made to simplify design by eliminating all unnecessary parts. Solid impeller hubs, stationary wearing rings of simple design, and the use of centering rings instead of dowels to align the channel rings all lead to a rugged design having ease of maintenance.

The two stages of reheat included in the cycle introduced a problem of heater drain disposal. The decision was to pump the drains forward directly back to the boiler, so that the drain pumps may also be considered as boiler feeders. For this purpose a special single-stage centrifugal pump was developed, the design of which is shown in Fig. 7. There are two per vessel. The unit is of vertical construction, single-stage, single-suction, and is driven by a variable speed d-c motor having a range of 2600 to 4000 rpm. The suction nozzle is welded to the piping which makes the casing a permanent installation. The complete pumping element may be lifted out for inspection or overhaul. A duplex ball thrust bearing carries the axial thrust load, and a self-contained circulating lube oil system is provided.

As the suction conditions are 1430 psi and 536 F, some means must be provided to give more favorable packing conditions. This is accomplished by the use of an injection and bleed-off bushing installed between the suction chamber and the stuffing box. Boiler feedwater at 250 F is injected into the bushing, and some 250-F water flows inward to the pump. The remainder flows upward and is bled off to a 30-lb point. The stuffing box packing is therefore subjected to only 30 psi and 250 F.

Total head developed is 259 ft at 3550 rpm and 62 gpm, giving a discharge pressure of 1514 psi. The variable-speed drive allows pump delivery to be varied to match the heater drain load. Illuminated liquid-level gages are provided on each heater for the convenience of the operator.

The foregoing discussion indicates the probable trends in near future feed pumps. The re-entry pump has captured the fancy of many plant designers. By varying stages, re-entry point and head per stage, an infinite flexibility of conditions can be achieved. Favorable heater arrangements and pressure ratings offer direct savings. It is also safe to predict that higher speeds than 3600 rpm will be sought, either for turbine or step-up gear drive. The pump manufacturer stands ready to investigate any new development which will be of value to the power industry.

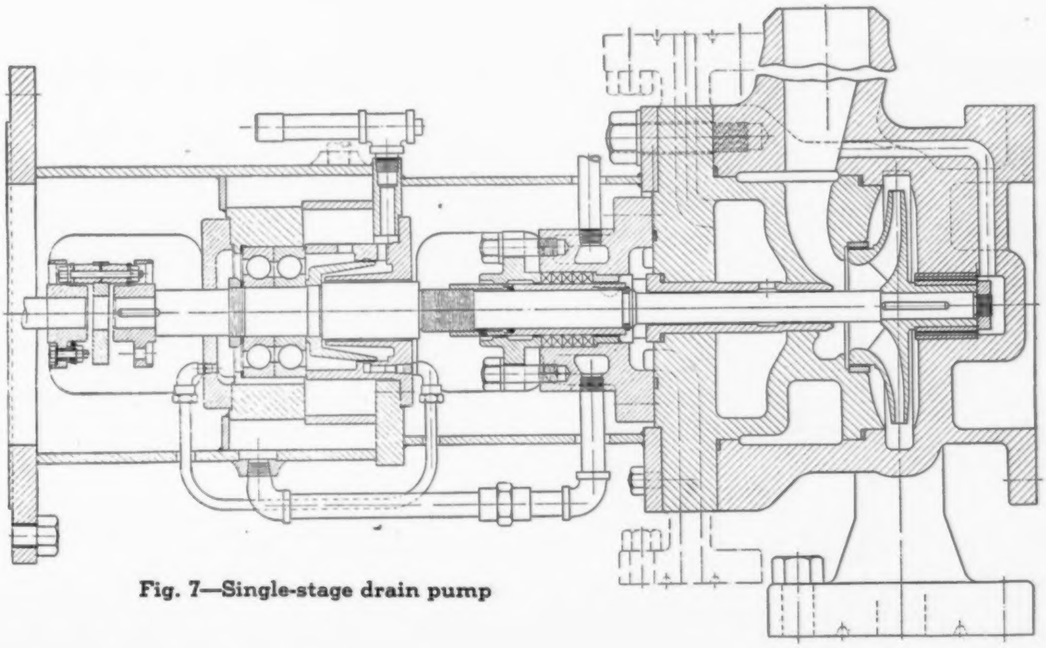
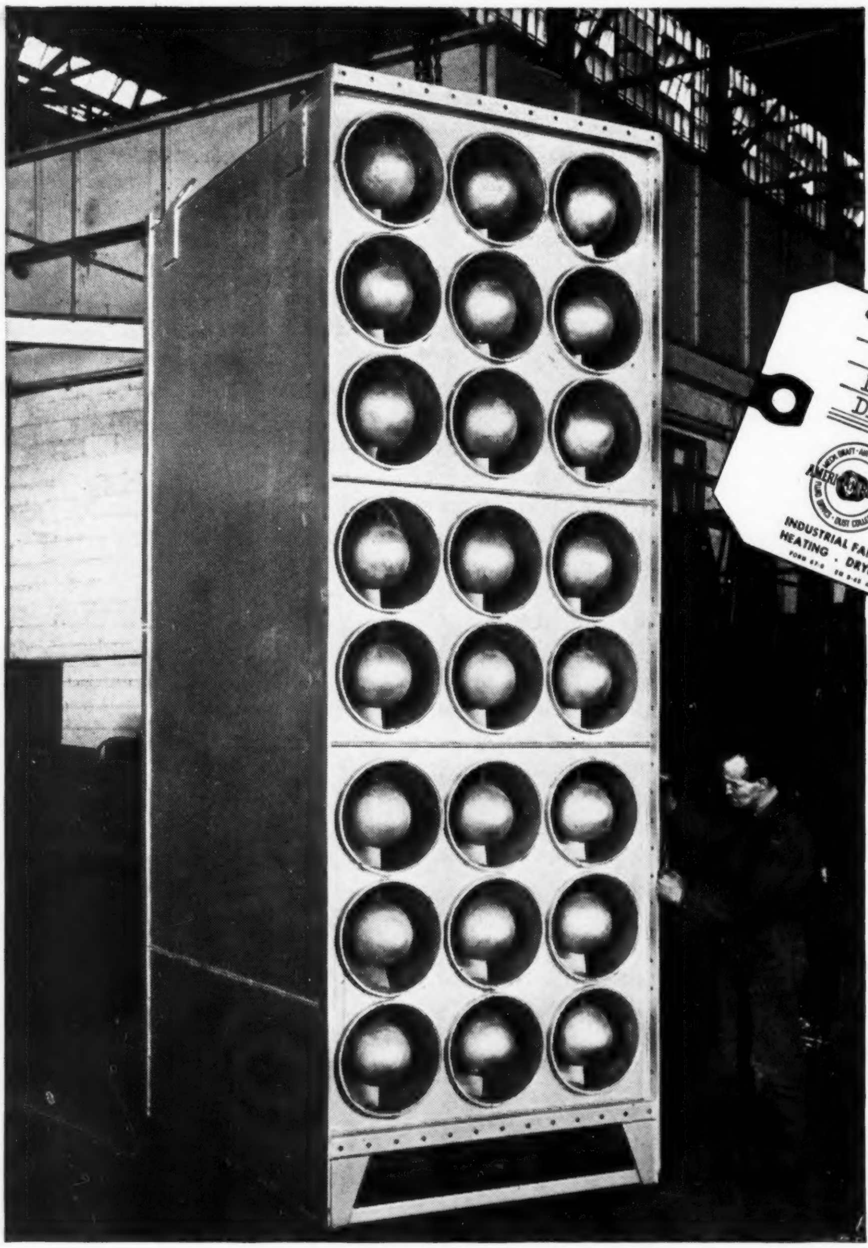


Fig. 7—Single-stage drain pump



One of six sections of an ST Fly Ash Precipitator for use with a 400,000-pound steam boiler unit, pulverized fuel fired. Unit is designed to handle 250,000 cfm of flue gases at 750° F.

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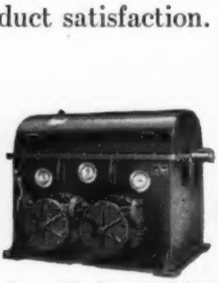
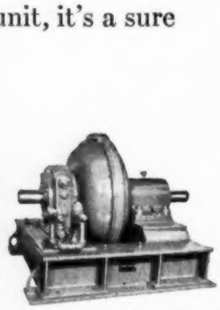


Type VS Class 6 Gyrol Fluid Drive—for adjustable speed control of boiler feed pumps.



Type VS Gyrol Fluid Drive—for adjustable speed control of mechanical draft fans.

AMERICAN BLOWER

*The Prevention of Turbine-Blade Deposits**

This relates trouble-free experience extending over 22 yr with 27 turbines in a number of 400- and 900-psi plants in which deaeration is accomplished in the condensers, evaporated makeup is employed and no treatment is given the boiler water.

By GEORGE C. DANIELS

Chief Mechanical Engineer,

Commonwealth & Southern Corp.

TURBINE blade deposits can only occur when solids are carried over with the steam. The most logical way to prevent the carryover is to eliminate the solids from the boiler water. In a straight condensing plant with evaporated makeup water the usual source of contamination is the condenser leakage and evaporator carryover plus various chemicals which according to generally accepted practice are fed into the boiler. Various reasons are advanced for adding chemicals to the boiler water, such as to raise the pH, to remove all traces of oxygen, to counteract any condenser leakage, to maintain certain chemical ratios, etc.

Long Experience without Feedwater Treatment

The purpose of this paper is to show from results of 22 yr of operation that the use of boiler feedwater treatment is unnecessary and that the total solids in the boiler water can be maintained at such a low value that no difficulty is encountered with turbine blade deposits. This experience covers the operation of thirteen turbines totaling 250,000 kw in capacity in sizes ranging from 7,500 kw to 30,000 kw operating at 400 psi and 750 F total steam temperature, installed in the years 1925 to 1931, and fourteen turbines totaling 455,000 kw in capacity in sizes from 20,000 kw to 50,000 kw operating at 900 psi and 900 F, installed in the years 1936 to 1941 in eleven plants.

The feedwater cycle in all of these plants, both 400 psi and 900 psi, is similar. Deaeration is accomplished in the condensers, no deaerating feedwater heaters are used, and a common suction header connected to an elevated surge tank is used for supplying all boiler feed pumps, even when supplying both 400-psi and 900-psi boilers in the same plant. Evaporated makeup water from concrete clear wells in the older plants and steel clear wells in the newer plants is deaerated by spraying into the condenser.

Some condensers on the 400-psi plants have one end of the tubes rolled in and the other end packed, while the rest, including all of the 900-psi plant condensers, have tubes rolled in at both ends. The 400-psi boilers are all of the straight inclined tube type, while the 900-psi boilers are all of the bent-tube type. All boilers are equipped with economizers except in two plants.

Oxygen in the feedwater for all of these units has generally been maintained at zero or a trace by the Winkler or modified Winkler tests. The deaeration in some of the earlier condensers is not as good as in those of later design and occasionally air leakage occurs around the stems of valves between the condenser and the condensate pump. The condensate pumps on all of the 900-psi plants were designed to keep both shaft packing glands sealed at pressures above the atmosphere and most of the 400-psi plants were also equipped with this type of condensate pump. In one of the early 400-psi plants, before testing the condensate for oxygen was practiced, severe turbine blade corrosion occurred, although the boilers were unaffected. So-called "red water" in the boilers has occasionally occurred before oxygen leaks were stopped or when the feedwater was passed through weighing tanks on turbine tests of several days' duration without deaeration, but no so-called "black water" in the boilers has

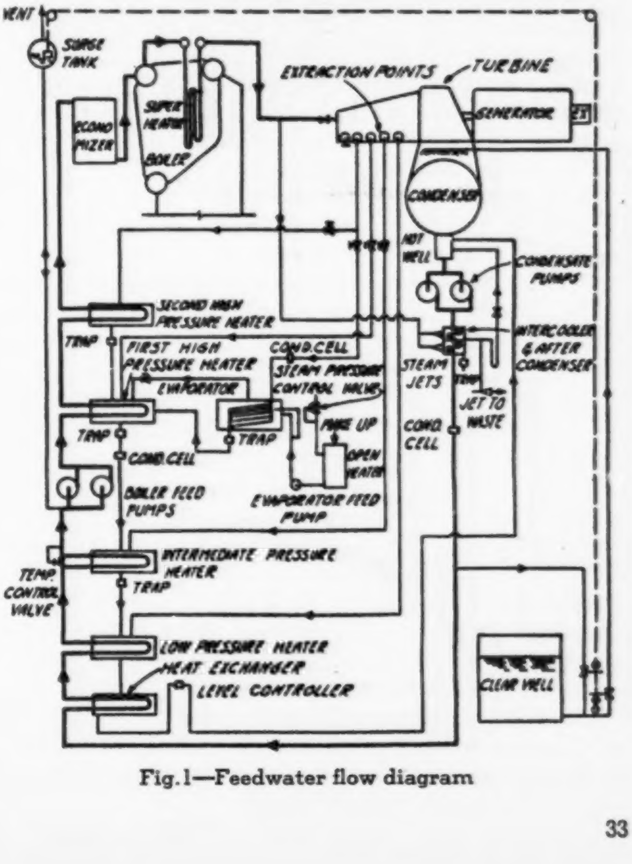


Fig. 1—Feedwater flow diagram

* A paper presented at the Semi-annual Meeting of the American Society of Mechanical Engineers, Milwaukee, Wis., May 30–June 4, 1948.

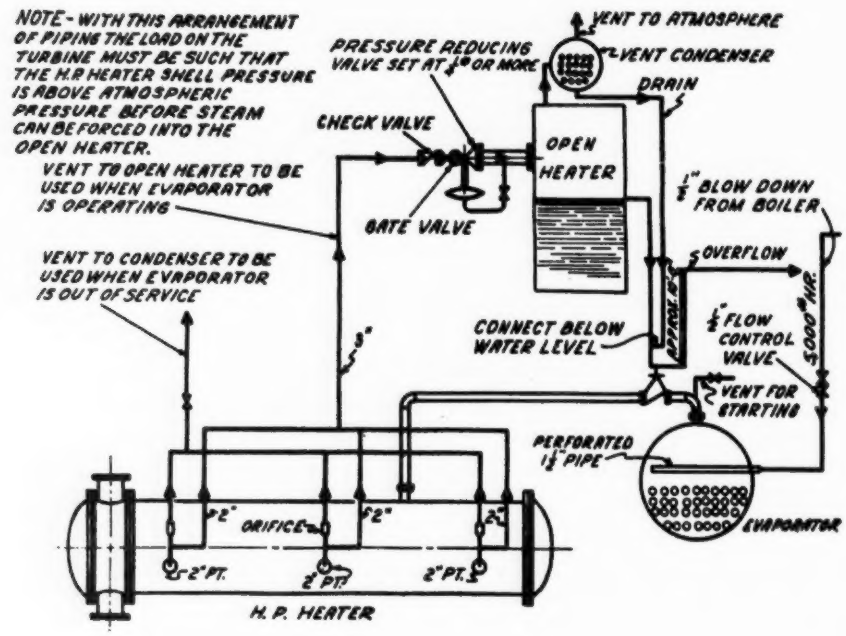


Fig. 2—Heater vent diagram

ever been observed. The boiler feed pumps show a brown or reddish film on the interior surfaces but no evidence of erosion-corrosion has been noticed either in the cast-iron or low-carbon-steel casings of these pumps. Recently, in one of the plants, chemical treatment under professional supervision was tried with the almost immediate result of erosion-corrosion of the cast-iron boiler-feed pump casings, whereas previously the casings were unaffected.

The total solids carried in the boiler vary in the individual plants. Several maintain $1^1/_2$ to 4 ppm of total solids in the boiler water, while others carry 10 to 40 ppm. The continuous boiler-water sampler helps to keep the concentration down and in addition a small amount of blowdown through a $^1/_2$-in pipe is used at intervals. Usually this blowdown is into the evaporator shell, which conserves the heat and is purer than the normal evaporator supply. In one recent installation the concentration in the boiler without any blowdown after two months of operation rose to 120 ppm.

Even with the low concentrations carried, some carryover occurs as is evidenced by the marked increase in boiler concentration, perhaps 30 to 40 ppm, which occurs when a turbine is put back into operation after an extended period of service and is then shut down for inspection or overhaul. In some plants the first condensate when starting up again is wasted for a brief period until the solid content is normal. While all of the 900-psi installations have some form of steam washers or scrubbers, the 400-psi plants were supplied with dry pipes, with only one exception where the boiler was equipped with a Tracy steam purifier with external drainage through a trap. The trap discharge which otherwise would have appeared as carryover accounted for most of the $3^1/_2$ per cent makeup water. The external drainage was shut off and the makeup dropped to approximately 1 per cent, where it has since been maintained.

Considerable attention has been given to the removal of CO_2 and ammonia before they reach the condensate from the condenser, so as to maintain a low conductivity meter reading of the condensate, usually between 1 and 2 micromhos; hence any condenser leakage shows up very quickly. These gases usually enter the feedwater system through the evaporator. Each turbine has its own evaporator and deaerating feedwater heater supplying the evaporator makeup. The first high-pressure heater, which also acts as the condenser for the evaporator vapor, is sufficiently vented to the evaporator supply deaerating heater to heat the makeup to approximately 212 F. The drains from the vent condenser on this heater, which usually contain considerable CO_2 and some ammonia, are run to waste. The practice of wasting the intercooler and aftercondenser drains from the steam jet air pumps varies with the plant and sometimes with the units in the same plant. In some installations the drains from the aftercondenser show much larger amounts of CO_2 and ammonia than the drains from the intercooler, and in other installations the reverse is true. Where well water is used for evaporator supply and no ammonia is present, it has been found unnecessary to waste the drains. Usually, however, with river water and especially in the wintertime, the drains from both the intercooler and aftercondenser are sufficiently contaminated with ammonia to amply justify their wastage. Where this has not been done or only the aftercondenser drains have been discharged to waste, condenser tubes in the air cooler section have sometimes been attacked and tube failures have occurred. The removal of the intercooler drains under vacuum can most economically and successfully be accomplished by means of a small water ejector on each intercooler.

Under the foregoing conditions of operation, condenser leakage is quickly detected by an increase in the condensate conductivity meter reading and the location of the leak determined by shutting off one-half of the divided water box condenser and draining. When the water drops past the affected tube the meter reading immediately falls to normal.

When using boiler feedwater treatment, it is necessary to carry a pH of 10 to 11 in the boiler water to avoid

corrosion. When no treatment whatever is used, the pH is usually between 8 and 9. It is seldom above this value but occasionally drops below 7.

During the early years of operating without feedwater treatment this caused some concern, but no evidence of any trouble with low pH has been encountered. In case the pH drops below 7 it is a direct indication of trouble in the boiler but not the cause. The first tube to fail due to cutting by the soot blower on one of the first-installed 400-psi boilers after 17 years of operation still had the original mill scale and roll marks on the inside of the tube. During the entire period of operation of the 400-psi boilers without feedwater treatment the tubes have not been turbined more than once or twice during 20 years of operation and then generally only to satisfy insurance inspectors. Failure of tubes in the 900-psi boilers has occurred after several years of operation due to iron oxide from the entire feed system accumulating in the boiler where it settled out in pockets or spots of low circulation, although the rest of the boiler was clean. Acid cleaning the boiler before it is put into service the first time and at intervals of several years thereafter should eliminate these tube failures.

Sources of Turbine Deposits

Internal boiler-water treatment introduces additional solids into the system which frequently hide out in the boiler, as described in recent literature, or are carried over with the steam and deposited in the superheater or on the turbine blades. Silica, which causes the most trouble from turbine blade deposits, may be present in the commercial grades of chemicals used for treatment or may come in as condenser leakage or evaporator carryover or from concrete clear-well storage tanks. With the other chemicals present it appears that complex silica compounds may be formed having widely differing characteristics as to their tendency to carry over with the steam, the nature of the deposit, and the temperature zone where they will deposit. The general practice of maintaining an excess of sodium sulphite in the boiler has frequently resulted in the production of hydrogen sulphide, and without the normal oxide film to protect the feedwater system, corrosion has resulted, and the corrosion-erosion of boiler feed pumps is common under these conditions. To counteract this corrosion, boiler water is frequently introduced into the feedwater system to raise its pH value.

In contrast to the complications arising from internal boiler-water treatment, with the relatively high concentrations carried in the boiler, usually resulting in turbine blade deposits, the simplicity of keeping the boiler water pure with very low concentrations in the boiler and no turbine blade deposits should be apparent. In spite of dire predictions of corrosion without the use of oxygen scavengers, with low pH and scale in the boiler due to circulating water contamination, these troubles have not materialized. After 10 years' experience with 400-psi boilers, the same predictions were made if higher boiler pressures were used. The same practice has been continued on the 900-psi units since their installation, and there is no reason to believe that it will not be successful with higher pressure installations.

The accompanying diagrams show a typical feedwater flow diagram and the method of heating the evaporator feedwater from the evaporator condenser vents.

Test Methods for Checking Water Level in Boiler Drums

By P. B. PLACE

Combustion Engineering Company

One method employs small-diameter test pipes with intakes at different levels and extending through the shell or head so as to permit free blow to atmosphere. These may have to be shielded to exclude spray and foam. Another method utilizes a test rod of material subject to attack by alkaline boiler water and shielded by an iron pipe.

IT IS sometimes necessary or desirable to check the water level in a boiler drum by methods other than by use of a gage glass. Many upper drums of multi-drum boilers are not equipped with water columns; a water column may not register the true operating level in the drum because of impact or aspirating effect of water flow adjacent to the column connections or because of leakage or deposits in the column circuit; and drums having submerged risers may have an appreciably higher operating water level in the active section of the drum than indicated by a water column attached to the end of the drum.

A common method of checking water level in a drum is to observe markings or deposits left in the drum after an operating period. Such marks, however, are usually misleading and may be so faint that definite conclusions are impossible. White chemical deposits on drum surfaces frequently suggest that the water level has been excessively high in the drum and inconsistent with gage-glass records. In most cases, such apparent level marks are false and produced by condensate washing the upper part of the drum shell during the cooling period after shutdown, particularly at the ends of the drum. During operation the drum becomes coated by contact with dirt-laden spray or foam. During the cooling period, condensate collects on the upper half of the drum and in draining down the sides washes off the thin deposits. At the ends of the drum, where drum nozzles give greater radiation and condensation, the indicated level directly under the nozzle is often several inches lower than indicated on adjacent surfaces. Also, if during the cooling period, the water is held at abnormally high level, it may have a high mark in the drum that may be mistaken for an operating level.

The use of small diameter test pipes located at different elevations in the drum, and arranged to allow free blow to the atmosphere, is a more certain method of checking the level in the drum and has a wide range of application. The inlet ends of the test pipes are located at fixed levels below and above the expected water level, and by blowing each to atmosphere in sequence it is possible to distin-

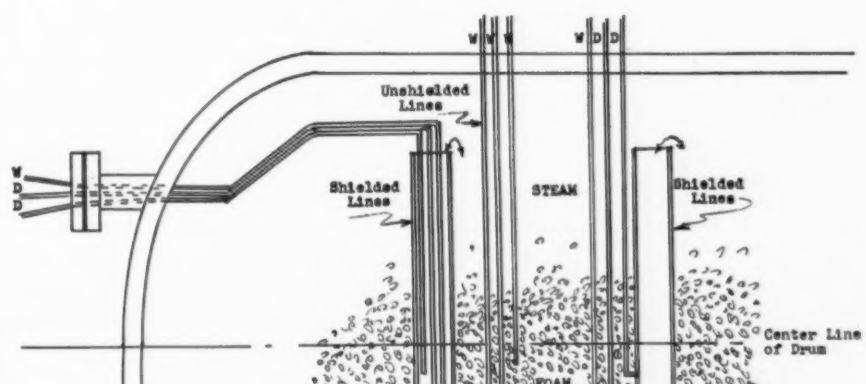


Fig. 1—Arrangement of shielded and unshielded test lines

guish between discharges of water and steam and to determine the operating level with reasonable accuracy.

A discharge of relatively dry steam from above the water level is characterized by being hot, more or less invisible like the superheated discharge from a steam calorimeter, and by the relatively small amount of water deposited on a surface held in the line of discharge. A discharge of wet steam, from a point adjacent to the water level, is cloudy and will vary in temperature and in the amount of water deposited on a surface. A discharge of boiler water alone will be relatively cool due to drop in sensible heat by evaporation. This temperature will be fairly steady, and large amounts of water will be deposited on a surface held in the line of discharge.

Application of this method requires an outlet through the drum shell for the blowoff pipes, external piping and valves suitable for the pressure involved; also manual operation. For outlet through the shell, a spare drum nozzle may be used with the several test pipes grouped and welded into a suitable flange connection. If permissible, the necessary outlets can be drilled through the shell or manhole cover and plugged after the tests are completed.

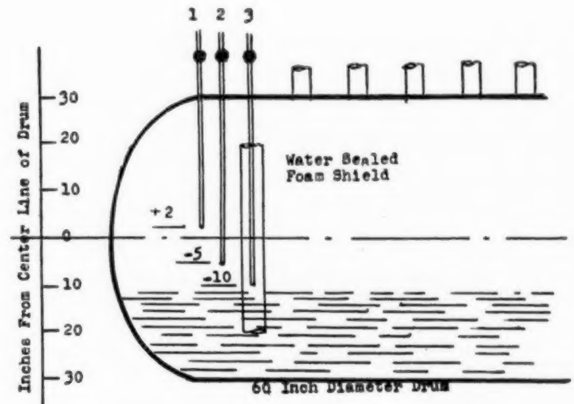
These test pipes may conveniently be $^1/_4$-in. pipe or steel tubing, the number depending on the information desired and the availability of outlets through the shell. Since the test lines are free blown, they may be located in any position as long as the inlets are at known elevations in the drum.

Care must be taken in locating the test pipes, and to protect them, so that the discharge represents true water level conditions, not affected by excessive spray, feed-line discharge, riser discharge, or foam. In upper rear drums, at ends of drums, and where boiler water concentrations are low and no foaming is involved, special precautions may not be necessary, but in many cases some form of shield must be placed around the test pipes to exclude spray and foam. This shield may consist of a length of pipe, not less than 4 in. diameter, open at both ends and long enough to extend above the foam level in the drum. The lower end is submerged to provide a water seal, and in regions of excessive spray the upper end may be fitted with a cone-shaped hood that will exclude spray but admit steam. The test pipes may be located within the shield or tapped into its side at the desired elevations. Fig. 1 shows a general arrangement of test lines, with and without a shield.

Where foam blankets on the water level are suspected, both shielded and unshielded test lines may be installed to check the water level and the level of foam on the water. Foam films contain so much water that their discharge often resembles the discharge of boiler water alone. In units operating with high boiler-water concentrations, water discharge is often obtained at elevations of 5 to 20 in. above the gage glass level. This is indicative of a thick foam blanket on the surface of the water in the drum.

When testing by this method, simultaneous readings of steam and water flow, gage glass water level, and blowoff observations should be taken under various operating conditions. Boiler water at high concentrations may produce foaming and only by dropping concentration below the critical value can the unshielded test line discharge be assumed indicative of the actual water level. By plotting the collected data, a complete picture of water level and foam level conditions at different ratings and at different boiler water concentrations may be developed.

This method also has some application for determining pressure differences in the drum that are reflected in the drum levels, or for checking accumulations of water in a dry drum or section of drum baffling where insufficient drainage is provided.



Rating M lb/hr	Water Level Inches	Blowoff Line No 1 (2)	Blowoff Line No 2 (-5)	Blowoff Line No 3 (-10)	Foam on Water Level Inches
175	-16	D	D	D	Under 11
175	-13	D	W	D	Under 15-Over 8
200	-16	D	W	D	Under 18-Over 11
200	-13	W	W	D	Over 15
225	-16	D	W	D	Under 18-Over 11
225	-13	W	W	D	Over 15

Boiler Water Concentration - 3000 ppm

Fig. 2—Foam and water level observations in 60-in. drum

Fig. 2 gives results of observations on foam and water levels in a single drum boiler under various conditions.

In drums having no available outlets for test lines, and no water column, the following method may be used to give an approximate determination of the average operating level.

A rod, tube, or strip of copper, brass, bronze or other metal subject to attack by alkaline boiler water is installed in the drum so that part of it is submerged and part of it is in the steam space above the normal water level. The test piece is protected against spray and foam by an iron pipe shield and allowed to remain in the drum long enough for the boiler water to corrode or produce a marking on the submerged portion of the test piece. Any number of these level indicators may be installed to give a complete survey of level across the drum and they require no outlet through the shell or manual operation during the test period.

This method is most applicable to boilers operating at a fairly steady rating and water level. In case the rating or level fluctuates during the test period, the test piece will register a shading of attack indicative of the range of level variation, with maximum indication at the average operating level.

The test pieces and pipe shield may be any convenient length from 18 to 30 in., each having a reference mark for designating their elevation as installed in the drum. The pipe shield may be of $1^1/_2$- or 2-in. standard pipe, fitted with a pipe cap and having one or two $^1/_8$-in. holes near the top, which serve as vents to allow free circulation

of water and insure a water level within the shield equal to that in the drum. The test piece is welded or otherwise fastened to the pipe cap so that it may be removed for inspection by removing the cap, without disturbing the fixed location of the shield pipe. Fig. 3 shows general details of such a test piece.

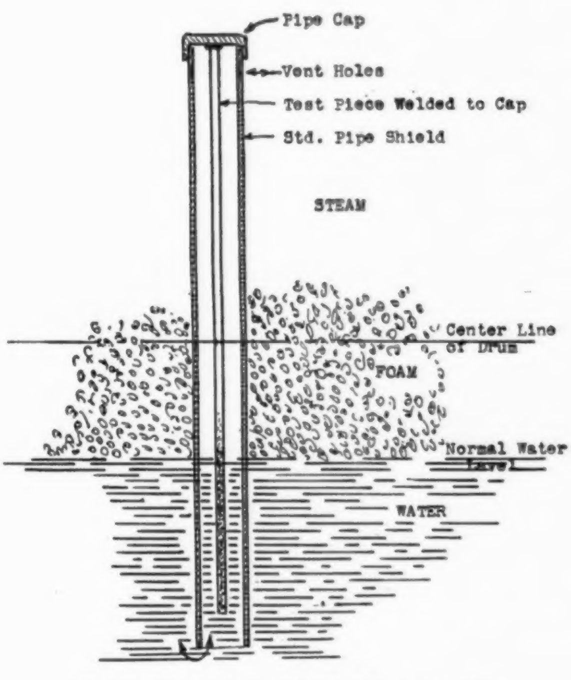


Fig. 3—Test piece shielded by iron pipe

The test period necessary for satisfactory registration depends on the test piece material and its resistance to attack by the boiler water involved. Very satisfactory markings have been obtained on a bronze rod after a week's exposure to boiler water of relatively low alkalinity and having less than 800 ppm total concentration.

During the test period, the rating and water level should be maintained as constant as possible and a record kept of average operating conditions. In order to avoid question about markings, the water level during the cooling period, after shutdown, should be kept several inches lower than normal, although the effect during the limited period before draining the unit is very small and in most cases negligible.

EQUIPMENT SALES

as reported by equipment manufacturers to the Department of Commerce, Bureau of the Census

Boiler Sales

Stationary Power Boilers

	1948 Water Tube		1947 Water Tube		1948 Fire Tube		1947 Fire Tube	
	No.	Sq Ft*	No.	Sq Ft*	No.	Sq Ft*	No.	Sq Ft*
Jan.	134	686,680	160	1,062,949†	76	119,047	106	106,788
Feb.	154	935,431	149	969,541	61	81,330	90	99,267
Mar.	173	1,062,816	167†	851,697†	65	91,241	80	109,984
April	188	1,152,992	176	1,027,313	87	112,170	71	102,315
Jan.–April incl.	649	3,837,919	652	3,911,500	289	403,789	347	418,354

* Includes water wall heating surface. †Revised.

Total steam generating capacity of water tube boilers during the period Jan. to Apr. (incl.) 1948, 39,004,000 lb per hr; in 1947, 46,094,000 lb per hr.

Marine Boiler Sales

	1948 Water Tube		1947 Water Tube		1948 Scotch		1947 Scotch	
	No.	Sq Ft*	No.	Sq Ft*	No.	Sq Ft	No.	Sq. Ft*
Jan.	—	—	2	7,724	—	—	—	—
Feb.	17	90,945	2	1,423	—	—	—	—
Mar.	30	204,262	5	22,232	—	—	—	—
April	12	76,228	11	6801	1	990	—	—
Jan.–April incl.	59	371,435	20	38,180	1	990	—	—

* Includes water wall heating surface.

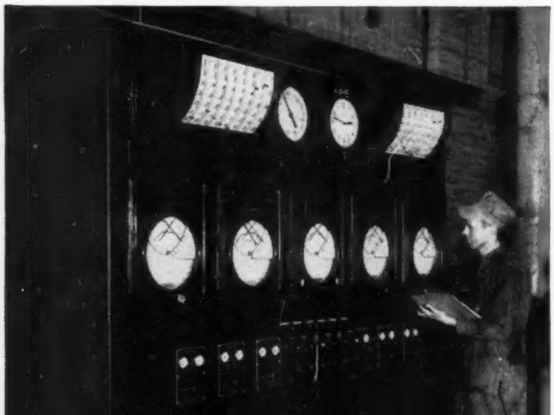
Total steam generating capacity of water tube boilers sold in the period Jan. to Apr. (incl.) 1948, 3,890,000 lb per hr; in 1947, 695,000 lb per hr.

†Mechanical Stokers Sales

	1948 Water Tube		1947 Water Tube		1948 Fire Tube		1947 Fire Tube	
	No.	Hp	No.	Hp	No.	Hp	No.	Hp
Jan.	52	48,887	67	32,532	116	15,983	148	22,320
Feb.	75	52,138	55	32,759	116	16,012	122	19,946
Mar.	97	57,042	55	26,959	152	21,155	225	29,705
April	127	61,947	63	36,914	209	30,695	111	19,649
Jan.–April incl.	351	220,014	240	129,164	593	83,845	606	91,620

† Capacity over 300 lb of coal per hour.

Loafing Btu's produce no power



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*Burning Anthracite in Power Plants**

By R. L. HALLMAN

Plant Betterment Engineer,
Pennsylvania Power& Light Co.

The handling of very small sizes of anthracite, such as Nos. 4 and 5 buckwheat, is discussed from the standpoints of unloading from cars, storage in bunkers, and discharge through chutes and spouts, particularly when wet. Conditions to be met and problems involved in burning such fuel on traveling grate stokers and in pulverized form are also reviewed.

THE term "small sizes of anthracite," as here used, includes: No. 3 buckwheat, or particles which pass through a $^3/_{16}$-in. and over a $^3/_{32}$-in. round hole screen; No. 4 buckwheat, or particles which pass through a $^3/_{32}$-in. and over a $^3/_{64}$-in. round hole screen, and No. 5 buckwheat, or particles which pass through a $^3/_{64}$-in. round hole screen, and silt, which is very fine but does contain a variable quantity of the coarser sizes. The specifications given for the prepared sizes are those accepted by the anthracite industry, although a few companies depart slightly. In some instances, small sizes of prepared anthracite are known by names other than the foregoing, namely, "Flotation Anthrafine B" and "Pulvacite." These two fuels are prepared for pulverization.

Smaller Sizes Now Predominate

The unavailability and the large increase in price of No. 3 buckwheat has forced the anthracite burning utilities to change the design of their combustion equipment so that Nos. 4 and 5 buckwheat and silt could be burned. The increased use of these smaller sizes has presented many problems not encountered with No. 3 buckwheat. Before discussing these problems, let it be understood that Nos. 3 and 4 buckwheat fuels are generally burned on stokers while No. 5 buckwheat and silt are generally burned in pulverized form.

No. 3 buckwheat moves or flows with relative ease. For instance, when the railroad car pockets are opened, the coal rushes out and only a small amount of handwork is required to empty the car completely. During very cold periods in winter, the unloading is more difficult as the coal freezes, but No. 3 buckwheat is much easier to handle than any of the smaller sizes, with the same exposure to weather conditions. Special coal-thawing facilities are seldom required unless very large quantities of No. 3 buckwheat are being handled. Similarly, it will flow through gates and chutes of rather small cross-section with only an occasional blockage. In the furnace, the fuel bed remains porous and offers comparatively little resistance to the flow of the required air for combustion. Only a small quantity of the fuel bed is put in suspension and carried out of the furnace with the exit gases. The small quantity of fuel in the exit gases avoids:

1. The problem of erosion of the various metal parts of the boiler.
2. A large carbon loss with the exit gases.
3. A material recovery problem.
4. High induced-draft fan maintenance.

As the size of coal decreases, all of the handling problems increase. The product known as "Flotation Anthrafine B" is perhaps the most difficult to handle.

Difficulty in Car Unloading

When the gates are opened on a car containing No. 4 buckwheat, only that coal directly over the gates falls out; the remainder must be manhandled unless expensive equipment be installed to take the place of the manpower. Car shake-outs, slicers and rotary car dumpers are popularly in use and add materially to the cost of coal-handling equipment. In the case of No. 5 buckwheat, "Flotation Anthrafine B," or silt, it is not uncommon to open the gates of a railroad car and not have any coal come out without the application of further effort. The only way to approach the time required to unload No. 3 buckwheat is to use rotary car dumpers. In order to handle the smaller sizes of anthracite in a frozen condition, whether 3-in. or 4-in. thick all around the car or 12- to 15-in. thick, or more, some kind of coal thawing equipment must be installed when coal in any quantity is being unloaded. There are several methods of coal thawing in use today; namely, steam lances, oil-fired thawing pits, oil-fired torches, thaw sheds employing hot air, steam, hot water or some combination of hot water and steam. In some isolated cases the cars are placed inside the power plant over night. A car of normally badly frozen coal will require from 2 to 3 hr. to thaw with the best thawing method being employed.

No. 3 buckwheat will pass through 12-in. or 14-in. gates and chutes wth a fair degree of satisfaction but the smaller sizes, especially No. 5 buckwheat, "Flotation Anthrafine B," and silt, will require about 30-in. square or round openings and even then more or less trouble will be experienced with blockages. In addition to the larger sized openings and chutes, it is often necessary, in order to obtain satisfactory operation, to line bunkers, chutes, hoppers and spouts with stainless steel or a nonferrous material. These materials present a very smooth surface over which the coal can slide more readily.

* Excerpts from a paper presented at the Sixth Annual Anthracite Conference, Lehigh University, May 6–7, 1948.

The moisture content of No. 3 buckwheat rapidly decreases to 7 or 8 per cent so that the water entrained with the delivered coal does not present any problem either in weight of material received by the consumer, in handling or combustion of the fuel. In fact, some moisture is considered beneficial to the process of combustion with stoker equipment.

As the size of the coal particles decreases, the surface area of the same weight of coal increases. The increase in surface area causes an increase in the entrained moisture and a decrease in the rates at which the coal loses its free water. Depending upon when the loaded coal is weighed, the time in transit and the tightness of the container, whether it be a railroad car or a truck body, governs the amount of water the consumer must receive, handle and purchase as a part of each ton of fuel. It is true that some railroads have a moisture allowance, in some cases a fixed percentage, in some instances a sliding scale, depending upon how long the cars were loaded before going over the scales and, in other cases, adjustments are made to weights made by truck delivery. At best these moisture allowances are not entirely satisfactory resulting in the purchaser buying water at the price of coal. The moisture content of the coal not only affects the cost of the heat units purchased, but presents handling and drying problems. Also, the frozen coal, with the higher moisture content, is harder to thaw and unload.

After thawing, unloading and handling facilities have been revised to accommodate the smaller sizes of anthracite, the furnace and stoker equipment must be redesigned if possible to achieve the best results.

A stoker installation to burn No. 4 buckwheat should be somewhat longer and be capable of operating at higher speed than for No. 3 buckwheat. The cost of increasing the length of a stoker is high, therefore the length is seldom increased. Usually the speed can be increased in some manner and this modification is made, although stoker maintenance increases with speed for a given design. The individual area of the air-admitting spaces should be reduced and the number of spaces increased in order to improve air distribution to the fuel bed and reduce the amount of siftings passing through the stoker; therefore, the stokers should be rekeyed.

Effect of Pure Stream Law

The passage of the Pure Stream Law, in the State of Pennsylvania, has resulted in the coal companies being faced with another problem in the preparation of their coal. Most of the coal companies prepare their coal by the use of water; therefore, they use the water over and over again to minimize the water-cleaning problem that must be met in order to have their discharge water entering the stream in an acceptable condition.

In the case of stoker sizes, namely, Nos. 3 and 4 buckwheat, this restricted use of fresh wash water results in dirty coal, although the size and ash content may not be excessive. The effect on the fuel bed when such coal enters the furnace is a surface caking or crusting as the moisture is driven off, and it becomes impossible to penetrate these sections of the fuel bed with the necessary air for combustion. This condition results in variable boiler capacity and high ashpit losses.

The shape and location of the arches should be changed because with No. 4 buckwheat ignition is maintained by blowing ignited fuel from the rear of the furnace to the front, and much of the fuel is burned in suspension while traveling from the rear to the front. Most of this size fuel is burned after it has been carried halfway through the furnace. The front arch need be only an ignition arch which really amounts to the bottom of the front wall. The rear arch should be at least half the length of the stoker. Its height above the stoker at the rear should be about 15 or 18 in. and that at the front end depends upon its length, so that the velocity of the gases will carry the ignited fuel particles to the front wall but not too high up on the front wall. Too much impingement on the front wall will tend to create a slag problem.

In some installations overfire air at elevated pressures and in some cases at elevated temperatures, is blown through nozzles located in the nose of the rear arch. It is usually directed at the fuel bed perhaps 24 to 36 in. from the front. Overfire air does several things: It reduces the quantity of air that must be forced through the fuel bed, thereby reducing the undergrate air pressure; it provides air for combustion where there would otherwise be a lack of oxygen; it creates turbulence to give better mixing of rich gases and air to aid complete combustion; and it strikes the coal particles, which are in suspension, and deflects them to the fuel bed instead of their going out of the furnace with the exit gases. Even so, a considerable quantity of these particles, which are in suspension, leave the furnace unburned.

If the gas passage areas in the boiler and other heat-recovery equipment have not been generously designed, the gas velocity will be high and the entrained particles traveling at high velocity will tend to erode various metal parts.

Reburning the Fines

Gases containing a high percentage of unburned carbon particles represent a corresponding loss in efficiency. To recover this carbon precipitators must be installed. After the carbon particles have been collected into hoppers, they are mixed with fresh coal and reintroduced into the furnace where at least some of the particles are burned. In some instances, the collected particles are returned to the furnace directly without being mixed with fresh coal before entering the furnace. Where coal pulverizing and burning equipment is readily available, it is desirable to transfer the collected material to the pulverizing plant where it can be burned in pulverized form as readily as pulverized fresh coal.

Induced-draft fans are usually installed on the larger units and because precipitators are not 100 per cent efficient, a considerable amount of erosion takes place in these fans and maintenance is further increased.

Anthracite, being a very low volatile fuel, is difficult to ignite and keep burning, therefore, the furnace temperature, whether for stoker operation or pulverized fuel firing, must be maintained relatively high in order to operate with a low carbon loss. In order to maintain this high furnace temperature, refractory furnaces or water-cooled refractory furnaces, must be employed. Elevated furnace temperatures result in increased slagging troubles so that a point must be determined which will result in an acceptable carbon loss and in a tolerable slag problem. Also, since anthracite is slow burning, when burned in a pulverized form, the furnace must be so designed that the flame travel is relatively long, in order to

provide sufficient time in the furnace to burn the coal particles to completion.

Anthracite in pulverized form is fired vertically downward, traveling from 20 to 25 ft. in this direction and then turning and going vertically upward for a distance of 40 to 50 ft., thus making the complete flame travel from 60 to 75 ft. in length before striking the bare boiler heating surfaces. Smaller units burning the highest volatile anthracite may operate with shorter flame travel.

It is important that pulverized anthracite be fed into the furnace in relatively small streams so that good mixing of coal and air can take place. In some cases air for combustion is introduced at four locations in the furnace: (1) with the coal known as primary or transport air, (2) through the vertical wall immediately behind the incoming coal and several feet below it, known as secondary air, (3) through the burner or ignition arch, between the coal burners and the furnace proper, and (4) around the burner nozzles.

The rate of heat released per unit of furnace volume is important for good operation, therefore a furnace of liberal proportions is required, and this adds to the cost of the boiler installation.

Heat release rates of from 8000 Btu to 20,000 Btu per cu ft of furnace volume per hour are in common use. However, the higher rates cause considerable slag troubles.

Pulverized anthracite operation results in about 80 per cent of the refuse passing out through the boiler and about 20 per cent dropping to the bottom of the furnace and being removed at that point. Because of the large quantity of material passing through the boiler, it is necessary to have ash-recovery equipment installed to protect the induced-draft fan. Mechanical and electrical precipitators are in common use today. Some companies employ mechanical collectors, others electrical and, in some cases, combinations of the two types have been found most effective.

Smoke Abatement's Wider Horizons

By J. H. CARTER

Commissioner of Smoke Regulation, Saint Louis, Mo.

Excerpts from a paper at the recent Annual Meeting of the Smoke Prevention Association of America in New York City, in which the author points out the complexity of the air pollution problem due to many factors other than smoke. A comprehensive research program is strongly urged to evaluate such factors. The work of several cities is also reviewed.

SMOKE abatement has now reached the era where it must accept as its recognized duty the control, not only of smoke, but of all the other undesirable elements that may inhabit a city's atmosphere. This expansion was inevitable and legitimate. That the Smoke Prevention Association has recognized this is apparent by reviewing its proceedings for the past several years. If smoke abatement officials had not voluntarily reached out to embrace the other pollutants of the atmosphere, they would have been compelled to do so by the weight of public opinion.

Recent studies made in Chicago[1] and Pittsburgh[2] show no connection between the amount of solids deposited out of the atmosphere and the rate of burning of fuel. The Chicago report is quite definite in this conclusion. "The seasonal dustfall pattern in Chicago," it reads, "is more nearly like the seasonal average wind velocity pattern than the seasonal coal consumption pattern.... The average dustfall reaches a peak in March; so also does average wind velocity. However, the average coal consumption reaches its seasonal peak in January." The report points out that dustfall and wind velocity vary in about the same proportion, whereas coal consumption has twice the variation and concludes, "This is evidence that other sources of dirt in the air contribute more steadily all year around than does the combustion of fuel."

Smoke Not Wholly Responsible

Yes, smoke, in fact the combustion processes, get blamed for putting lots of undesirable particles in the air for which they are not responsible. Soot (when it really is soot), fly ash, cinders, fly carbon, all come from the combustion process; but practically every manufacturing process, every transportation activity, in short, every movement made in the course of human existence contributes some dust to the atmosphere. And these are just the "man-made" particles. Nature adds a still more bountiful supply. From the erosion of soil, the eruption of volcanoes, the shedding of foliage in the fall, from out of the dim, dark depths of the cosmos comes dust which permeates our atmosphere and makes possible life on this planet. "Without dust there would be no rainfall. Without it there would be no vegetation and, consequently, no animal life. Without it the sun's rays, un-

[1] "A Comparison of Seasonal Variations in Dustfall and Other Factors Related to Air Pollution," Report of Chicago Association of Commerce, June 1946.

[2] "Dustfall and Its Relation to Smoke," by Sumner B. Ely, *Proceedings*, S.P.A.A., 1946.

broken by dust particles, would be unbearable during the day and the nights would be intensely cold."[3] Somewhere between the amount necessary to support life and that found in the atmosphere of our present-day cities lies the dividing line between beneficence and nuisance. The air pollution engineer will have to find that line and devise means to keep the dust loading of his city's atmosphere from crossing it. The public will demand it of him—in fact is demanding it now.

Condensation Nuclei

So we have smoke and dust in the air. We know they are there because we can see them. But in addition aerosols are present in still greater quantities which we cannot see because they are invisible. For want of a better name, these are called "condensation nuclei." As their name indicates, each particle forms a nucleus upon which moisture in the atmosphere condenses, the droplets increasing in size as they attract more moisture until, under proper conditions, haze or fog results.

Besides being unique because of the great numbers present in the atmosphere and, by being invisible, these nuclei are distinguished because of the sources of their emission. The majority originate from natural sources, but the man-made sources are legion.

Neuberger[4] says "Nuclei are produced wherever substances or processes give off odoriferous fumes where materials are glowing hot, or combustion takes place, whether visible smoke is emitted or not." So the smoke abatement engineer who is successful in eliminating the smoke emission from a chimney has not decreased one whit the number of condensation nuclei discharged from that stack. The question is naturally raised then, "Of what interest are condensation nuclei to the smoke or air pollution engineer? If we cannot prevent them and cannot see them, why bother with them?" However they are of distinct interest to any modern air pollution control program, and a determination of the quantities in which they are present in a city's atmosphere from day to day is requisite to a proper evaluation of the results of control measures against smoke and dust.

The smoke abatement engineer's horizons grow wider and wider but, as they expand, one should pause to clarify some of the issues involved. As we contemplate the many different kinds of pollutants in the air and the myriads of sources from which they emanate—many of them admittedly outside of control—there is likely to be a feeling of frustration. That is very definitely a defeatist attidude.

There is apt to be a tendency to belittle the efforts of cities in which legislation against smoke is being earnestly considered. That is unfair; but what is still more unfair is the tendency to blame existing, active smoke regulation efforts because they have not already eliminated all the many other pollutants from the atmosphere.

Work Divided in Cleveland

The City of Cleveland (Ohio) has made an excellent start in this direction. In its Department of Public Health and Welfare there has been established a Division of Air Pollution Control, headed by a Commissioner and with a division staff. As parts of this division there are three bureaus—the Bureau of Smoke Abatement, the Bureau of Industrial Nuisances and the Bureau of Industrial Hygiene. Each has, or will have, its own technical staff chosen with regard to ability to carry on that bureau's specialized branch of air pollution work; and under the Commissioner, available to all three bureaus, is a laboratory with its own staff. The names of the bureaus indicate the branch of air pollution work each will be called upon to follow. This appears to be an air pollution control organization set up with a full realization of the factors involved and the personnel required to handle them. Results in Cleveland will be watched with a great deal of interest.

The important thing is that we recognize the value of each phase of the air pollution program. The smoke abatement branch is still just as requisite a part of the work as it ever was. It should be the first line of attack for any community entering the lists, for technical as well as psychological reasons. Technically this is so because the methods which will lead to practical elimination of smoke are well known. Modern, scientifically designed equipment, wise selection of a wide variety of fuels, careful and intelligent operating—one or more of these properly applied— will reduce to a minimum the smoke from any fuel-burning plant. Psychologically, it is so because the smoke which still hangs over many of our American cities seems to be the most objectionable of the atmospheric pollutants from the public's viewpoint. At any rate, it is their first subject of complaint. One would evoke little enthusiasm from an irate citizenry by talking to them about condensation nuclei when they couldn't see across the street because of existing smoke palls.

Ordinance Requirements

Smoke abatement, like traffic regulation, requires an ordinance with penalties and an enforcement organization ready to invoke these penalties. Legislation will not clear the air, but the air will never be cleared without it. Let us not belittle the efforts of any smoke inspector earnestly striving to reduce the inexcusable, dirty emissions from the chimneys of his community. He is laying the cornerstone for ultimate, complete air pollution control. And by attacking and eliminating the visible sources of contamination he may be eliminating many invisible and unsuspected sources at the same time.

We need take only one step onward from the suppression of visible smoke into the realm of air-borne dust to be practically strangers in an uncharted field. We do not know what part of the total any of the many sources contribute, how much there is altogether, how much or how little should be considered a nuisance, or how close to that limit we can approach by practical measures. There is great need for extensive research into atmospheric dust. It must be made if we are to have answers to enough questions to enable us to draw up effective control measures. The Smoke Prevention Association should take the lead in this matter by sponsoring such a research program, which should be got under way at the earliest possible moment.

Several of our larger municipalities have enacted air pollution legislation within the past few months. In

[3] "Dust Problems," Third Edition, by Hudson H. Bubar.
[4] "Condensation Nuclei—Their Significance in Atmospheric Pollution," by Hans Neuberger, *Mechanical Engineering*, March 1948.

every case, provisions have been included limiting the quantity of fly ash or, let us say, solids that may be emitted by coal-burning boiler plants. Other cities have tightened up on their existing fly-ash provisions. The purpose of these measures was not to penalize that particular tye of fuel-burning equipment; it was to reduce the volume of solids in the air which settle out on citizens' belongings and against which they complain most bitterly. It has all been predicated on the assumption that the biggest part of a city's atmospheric dust is fly ash.

Efforts Being Made to Establish Standards

But who can say whether that assumption is correct? The subgroup of this Association's Standardization Committee, which has been working on a standard for the emission of fly ash from chimneys, wishes it had the answer to that question. After three meetings and much discussion by mail, the subcommittee has arrived at one definite conclusion and that is that there are not sufficient data available on which to base a comprehensive and logical stack-emission ordinance. However, it realizes that the cities will not wait while we make up our minds to do some research and is attempting to bring forth a regulation, based on the information at hand, which will contribute to the reduction of dust in the air and, at the same time, not work undue hardship on those who must equip to comply with it. In furtherance of this work, the subcommittee prepared a questionnaire containing a tentative ordinance clause. Copies were sent to the smoke abatement officials of all cities, as well as to other interested and qualified groups such as the American Boiler and Affiliated Industries, the Edison Electric Institute, the Association of Edison Illuminating Companies, the American Society of Mechanical Engineers, and others. With all the replies before them, the subcommittee hopes to be able to offer the Smoke Prevention Association a fly-ash clause which will represent the best thinking on the subject and which will serve until comprehensive research provides the undisputable answers.

Limitations of Visibility Operations

Research is also needed to develop a yardstick by which accomplishment in smoke and dust abatement can be measured. In other words, some way must be found to evaluate quantitatively the smoke and dust in the atmosphere. Year after year this Association has passed resolutions calling upon the United States Weather Bureau to enter into some such a project. One research program, which it is hoped will lead to a method for measuring atmospheric smoke, is getting under way now in the Middle West. But until we have something better, we must rely on visibility readings. The public is accustomed to gage the clarity of the air by how far one can see through it. The Weather Bureau goes farther than that and actually evaluates the smoke in terms of "light," "moderate" and "heavy," based entirely on visibility readings. Its system operates something like this: If the relative humidity is close to 100 and the visibility is greatly reduced, it reports "fog." But if the humidity is not near the saturation point and the visibility is low, it reports light, moderate or heavy smoke, depending on the distance from the station at which landmarks can be distinguished. If humidity is somewhat high but not high enough alone to account for the reduced visibility, then it records "fog and smoke" —the smoke being assumed to be present to explain the additional obstruction of vision.

But we are told that because of the great numbers of condensation nuclei present over industrial centers, the transparency of the air is "markedly reduced" at relative humidities "far below the saturation point." It would appear, therefore, that visibility readings are acceptable as measures of the visible pollutants of the air only when the number of condensation nuclei present is known and the effect these nuclei have on the range of vision. We need either a new technique for the quantitative evaluation of smoke and dust in the atmosphere, or must take into account all the factors which affect visibility if that is to be the criterion.

No sooner do we begin to make some headway against smoke than we are called upon to do something about fly ash. As soon as we get into the fly-ash problem, we find it involved with all the other pollutants of a city's air. The day of the smoke abatement engineer is not past—his horizons are merely being pushed wider and wider, giving him boundless opportunity for greater development and more service to his community.

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Sees Need for Expansion in Bituminous Coal Capacity

SPEAKING before the "Coal and Fuel Oil Forum" at the Annual Meeting of the National Association of Purchasing Agents in New York, May 31, 1948, H. A. Glover, vice president of the Island Creek Coal Sales Co., gave some pertinent facts concerning the sources of bituminous coal output, factors affecting quality, and plans for expansion of productive capacity.

While the coal industry last year produced 620 million tons of bituminous coal, present and indicated future requirements point to the necessity for more mines and improved cleaning and preparation plants. In fact, many companies are now engaged in planning and constructing new mines and new surface facilities embracing the latest cleaning and sizing equipment, much of which has been developed during the last five years. However, all of these mines do not represent additional capacity as some will replace old mines that are becoming exhausted.

Furthermore, completion of these new facilities is being delayed because of slow deliveries of materials. Before the war delivery of such items as cutting machines, drills, motors, loading machines and pit cars could be had within 60 to 90 days, but today the manufacturers of such equipment have orders ahead for two or three years.

Sources of the 1947 Production

Of the 620 million tons of bituminous coal mined in the eleven working months of 1947, approximately 125 million tons were produced by strip mining. While some of this coal was of excellent quality and, when properly prepared, compared favorably with coal mined underground from the same seams, much of it was of inferior quality and received no preparation at all. In many cases this was because the available acreages were too small to warrant adequate cleaning and preparation facilities.

Between 75 and 80 million tons were mined from so-called "snow-bird" mines. These are temporary underground mines without rail connections and without tipples. They varied in output from a few tons to a few hundred tons per day and the coal was largely loaded into trucks as mine-run coal and dumped into cars over ramps. While such coal served to alleviate critical shortages, it was not usually of a desirable quality.

Of the remaining 400 million tons which came from deep mines, approximately 100 million tons was the product of small mines not equipped with modern tipples, cleaning or sizing plants. While a substantial portion of this was good coal, and excellent for many purposes, from the standpoint of size and preparation it did not have the elasticity necessary to meet diversified market requirements.

It might be pointed out, however, that no producing district has a monopoly on good coal and good preparation.

American and British Output per Man-Shift Compared

The mechanical efficiency of American coal mining is greatly envied by foreigners who have been unable to approach our standards. For example, in 1947 the American underground bituminous coal miner produced 5.8 tons per man-shift while his British counterpart produced 1.2 tons per man-shift. The former is paid approximately three times as much as the latter and in January 1948 averaged $75.91 weekly. However, thousands of American bituminous coal miners earn $400 to $500 per month and more.

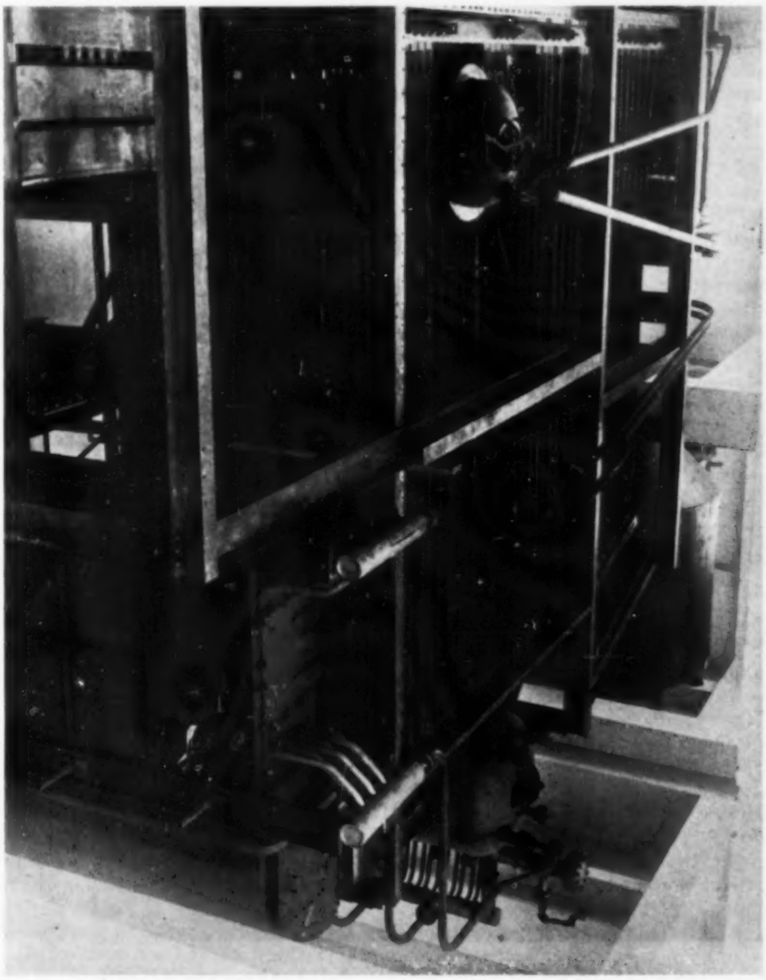
In 1936 in this country 477,000 miners produced 439 million tons of bituminous coal, whereas eleven years later 399,000 miners produced 620 million tons, despite a strike of 4 weeks. This was due to increased mechanization. Nevertheless, the mine owners have been forced to turn over to the miners most of the benefits achieved through mechanization.

Mr. Glover estimated that the industry would need to spend from 500 to 600 million dollars in the next few years for new plants and equipment; that when and if the present spiral of inflation begins to level off, coal prices will also level off; and when and if, through amendments to the Labor-Management Act and the Anti-Monopoly laws, a proper basis is established for labor-management relations, continued steady operation of the mines should convert the present sellers' market to a buyers' market for coal.

Continental Enters Power Equipment Field

Continental Foundry & Machine Co., operating plants in Chicago, Pittsburgh and Wheeling, scored the first entry of basic heavy industry into the power plant equipment field through the purchase of two established equipment producers. These are Vulcan Soot Blower Corp., DuBois, Pa., and Northern Equipment Co., Erie, Pa.

The Vulcan Soot Blower Corp., founded nearly fifty years ago, is one of the leading producers of equipment for cleaning high-pressure power and heating boilers. The new officers and directors of Vulcan are:



One of two C. E. steam generating units under erection at Eskisehir, Turkey for the Turkish State Railway

George L. Davis, formerly vice president of Diamond Power Specialty Corp., president; D. E. Hibner, vice president; W. N. McCreight, secretary; also Arthur Kuiper and William B. Todd, directors. Other former management will remain and all business activities will continue to center in DuBois.

Northern Equipment Co. is the producer of Copes boiler feedwater regulators, Copes reducing valves, Copes desuperheaters and related products. The present management will remain and will include the following as officers and directors: E. W. Nick, president; V. V. Veenschoten, vice president; William L. Hunter, general manager; also George L. Davis, Arthur Kuiper and William B. Todd as directors.

Electric Output Still Climbing

Production of energy by electric utilities during May totaled 22,608,771,000 kwhr, according to the Federal Power Commission. This was the highest May production on record, exceeding that of May 1947 by 8.8 per cent. Of this total output fuel-burning plants produced 66 per cent, or 14,925,115,000 kwhr.

For the twelve months ending May 31, 1948, electric utility production was 266,482,683,000 kwhr which represented an increase of 11.3 per cent over that of the previous twelve months.

During May 1948, electric utility power plants consumed 7,111,794 tons of bituminous coal, 314,136 tons of anthracite, 2,943,412 bbl of oil and 39,390,491 mcf of natural gas. These figures were, respectively, +2.8 per cent, −4.5 per cent, +32.8 per cent and −9.8 per cent compared with the May 1947 consumptions.

The total installed capacity as of May 31, 1945, was 53,834,000 kw, which included an increase of 254,824 kw during that month.

According to the same source, industrial production of electricity was 4,426,587,000 kw during May which was an increase of 4.6 per cent over the same month last year. The total installed industrial generating capacity is given as 12,942,497 kw.

Combined utility and industrial production during May 1948 was up 8.1 per cent over that of a year ago and the twelve-month output was up 10.3 per cent.

Mobile Power Plant to Return from Mexico

One of the Navy's two 6-car, railway-mounted, mobile power plants, which has provided emergency power to relieve an industry-crippling power shortage in the Guanajuato section of Mexico since February 1947, will be returned to the Philadelphia Navy Yard early in August.

Mexico has been able to relieve the regional power shortage, caused by drought, by the construction of a 10,000-kw steam power plant near Celaya, where the mobile plant was operated.

The other Navy mobile power plant is now providing similar emergency service for the Salt Creek Water Users Corporation in Arizona, and is scheduled to remain there until October.

Both power trains were built for the Navy by the Bureau of Yards and Docks in 1941 to provide emergency service in the event of wartime damage to naval plants. Although such occasions did not arise, the units have been usefully employed in a number of instances to help out power shortages in various localities.

New Books

Obtainable through Combustion Publishing Co., 200 Madison Ave., N. Y.

Elementary Steam Power Engineering

By Edgar MacNaughton

Third Edition

The general presentation resembles that of most textbooks, except that there is some departure from the usual sequence of topics by having the practical discussion precede the theoretical; and the text is more profusely illustrated. Each chapter is followed by a number of carefully selected problems.

Major changes since the previous 1933 edition include ASA symbols and abbreviations, abridgment of the latest steam tables, rewriting of much of the text to accord with advancing practice, and the inclusion of additional material, especially on thermodynamic principles and on turbines. That some more or less obsolete illustrations have been retained from the previous edition may perhaps be excused by the fact that some such equipment is still in service.

The book contains 640 pages, 6×9 in. with 497 illustrations and 43 tables. The price is $6.50.

From the Ground Up

By Paul M. Tyler

This unusual title deals broadly with the rôle of minerals in our national economy, their production and consumption, the properties and uses of minerals, some misconceptions about mining and national policies with reference to conservation. Of particular interest to power engineers is the chapter on "Our Energy Supply," which deals with coal, oil and gas resources and production, although the whole text makes most interesting reading.

The book contains 248 pages, illustrated, and is priced at $3.50.

International Industry Yearbook 1948

Edited by Lloyd J. Hughlett

As stated in the introduction, this is the first issue of an annual publication planned to summarize the technicological progress achieved in the various fields of engineering and industry. Chapters dealing with these subjects have been prepared by contributing authors, each prominently identified with his respective field.

Following an introductory chapter on "World Industry," by Mr. Hughlett, the contents include: industrial research; air conditioning, refrigeration and heating; cement and rock products; chemicals; communications; compressed air; the electrical industry; electronics; food packing; glass, porcelain and ceramic industries; industrial design; industrial illumination; materials handling; physical metallurgy; metal working; mining; industrial packaging; pulp and paper industry; paint varnish and lacquer industries; petroleum; plastics; the power industry; railroads; rubber; standardization; and textiles.

The text serves both as a clearing house of general information on technological progress in industry and as a convenient reference.

There are over 400 pages, splendidly printed and profusely illustrated, and the size of the page—$8^1/_2 \times 11$ in.—enhances the effectiveness of the illustrations. The price, bound in cloth, is $10.

Business Notes

L. D. Litsey has been appointed Chicago area representative for worm-gear speed-reducers of the **De Laval Steam Turbine Co.** His headquarters will be at 6459 North Sheridan Road, Chicago 26, Ill. Other De Laval products will continue to be handled by the Company's district office in the Peoples Gas Bldg., Chicago 3.

●

Dearborn Chemical Co. announces the assignment of F. E. Rolston to territory comprising Louisiana, Arkansas and part of eastern Texas. He will be temporarily located in Shreveport, La. This district was previously covered by Tom Holcombe.

●

A. A. Kalinske, formerly chief hydraulic engineer for **Infilco, Inc.,** Chicago manufacturer of water purification, sewage and waste treatment equipment, has been promoted to the position of director of development.

●

Elliott Co., Jeannette, Pa., has assigned A. V. Wood as field engineer in its Detroit District Office, and L. B. Rahn as field engineer in its New York District Office.

●

Edward Valves, Inc., East Chicago, has started construction on a new building to house its metallurgical, physical and chemical laboratories. These added facilities, which will nearly triple its present research department, will be used for research and development work on Edward and Nordstrom steel valves.

●

Gilbert Associates, Inc., well-known firm of consulting engineers, Reading, Pa., has opened a branch office in Houston, Tex. It is located in the Oil & Gas Building with Aaron P. Campbell, vice president, in charge.

●

Bailey Meter Co., Cleveland, Ohio, has opened a new branch office in the Independence Bldg., Charlotte, N. C. It is in charge of J. R. Powell, assisted by R. T. Cathey.

Further Underground Gasification Test

A contract has been entered into between the Bureau of Mines and the Alabama Power Company for a second and larger cooperative experiment in underground coal gasification at Gorgas, Ala.

The initial joint experiment last summer showed that gases produced by burning unmined coal offer a potential source of fuel for power and raw materials for synthetic liquid fuels. If proven feasible, underground gasification offers alluring possibilities for minimizing expensive mining and for utilizing coal veins difficult or uneconomic to mine.

Cost of the large-scale field test is estimated at $411,000 for a one-year period. Under the contract, the company will provide engineering and operating services on an actual cost basis (without profit), and will contribute as a site for the experiment some 300 acres of Pratt seam coal averaging 40 inches in thickness.

The site-preparation work is expected to be completed next fall, at which time interested persons will be invited to inspect the underground workings before the coal bed is fired for the first experimental run.

Objectives of the experiment are:

1. To determine the quantity of coal which can be gasified from a given combustion zone and the shape and extent of the burned-out area formed.
2. To determine whether fixed outlets for product gas are practicable, either at the outcrop of the coal bed or at vertical bore holes. Various designs of inlets, outlets and seals will be tested.
3. To determine the operating characteristics of the installation under a variety of conditions.
4. To determine the quality and quantity of product gas generated with an air blast under experimental conditions and, secondly, the quantity of tar and related products obtained.
5. To obtain information on the effect of heat on the overlying strata.
6. To obtain fundamental technical and economic information concerning plant sites, installations and operating processes.

Last year's experiment showed that combustion could be maintained and controlled, that coal in place could be gasified completely, and that the roof rock would become plastic, expand and settle down behind the burning coal face without cutting off the air or gas. The gas obtained, however, was of lower heating value than desired. This was attributed to leakage of gas and air pressure through cracks and breaks in the thin, 30-foot cover over the burning coal seam.

To correct this fault, the new experiment will be carried out at a much deeper level, 100 feet or more, and with much heavier air pressures and higher temperatures. These factors are expected to increase the average heating value of the gas produced with an air blast from the 47 Btu per cu ft obtained last year to from 70 to 125 Btu. Oxygen and steam can improve the gas quality further, as was shown in the first field trial when runs made with an oxygen-enriched air blast, an oxygen-air-steam blast, and an oxygen-steam blast, which increased the average heating value of the gas produced to 50 110, and 134 Btu per cu ft, respectively.

Japanese Wartime Liquid Fuel Supply

Nearly 110,000,000 gal of Japan's wartime liquid fuel supply were made from coal by low-temperature carbonization, according to a survey conducted by the U. S. Bureau of Mines.

Ten carbonization plants—six in Japan and four in Korea and Karafuto—produced nearly all of the liquid fuel from coal, most of which was bunker oil for ships' boilers. However, in addition to the liquid fuel, the low-temperature carbonization plants produced semi-coke that was used for cooking and heating, for fueling portable gas producers on motor vehicles, and for replacing imported low-volatile bituminous coal in coke-making.

War damage to the plants was so severe that when they were visited between April and August 1946, only three were in operating condition or so slightly damaged as to need only minor repairs.

Roving Industrial Exhibit

With a view to stimulating widespread interest in industrial development the Mexican Government has sponsored a railroad train display caravan which will tour the country during the next two years. The train consists of 33 freight cars, of which 22 will exhibit various Mexican industrial products and 11 (flatcars) will carry agricultural machinery and carnival equipment. Among the exhibits will be an active radio station and a 200-kw power plant.

All towns of any importance situated along the railroad lines will be visited for several days. Salesmen will explain the products, and efforts will be made to interest distributors and retailers of the goods shown. A further objective is to educate the general public in the desirability of consuming such articles and to make known the progress their country has made.

Coal Stocks

Coal stocks on hand at electric utility power plants on May 1, 1948, according to the Federal Power Commission, totaled 13,758,294 tons. This represented a decrease of 9.2 per cent compared with stocks a year earlier and 12 per cent below stocks of the preceding month. In terms of days' supply, based on the rate of consumption for the month of April, there was sufficient coal on hand May 1 to last the industry 57 days.

James M. Todd to Head A.S.M.E.

James M. Todd, New Orleans consulting engineer, was nominated as the next president of The American Society of Mechanical Engineers during the Semi-Annual Meeting in Milwaukee, May 30–June 5. His name heads a slate of new officers, including several regional vice presidents and directors-at-large, submitted by the nominating committee. Formal election will take place in the fall by letter ballot of the membership and the 1948–1949 term will begin at the end of the annual meeting next December.

Mr. Todd, who will succeed E. G. Bailey of New York as president of the Society, was born in Franklin, La., in 1896 and was graduated from Tulane University in 1918 with the degree of B.E. In 1930 he received the degree of M.E. During World War I he served in England and France as a lieutenant of engineers. After the war he became chief engineer of Penick & Ford Ltd., formerly of New Orleans and now of Cedar Rapids, Iowa. Later he was associated with A. M. Lockett and Co., mechanical engineering contractors of New Orleans, resigning to engage in private practice. Previously he held offices as manager and as vice president of the ASME, and served on many of its important committees. He became a Fellow of the society in 1944.

Other officers nominated are:

As regional vice presidents: Arthur Roberts, Jr., chief engineer, Lynchburg Foundry Co., Lynchburg, Va.; Forrest Nagler, chief mechanical engineer, Allis-Chalmers Mfg. Co., Milwaukee; Carl J. Eckhardt, professor of mechanical engineering and superintendent of utilities, University of Texas, Austin; Albert R. Mumford, development engineer, Combustion Engineering Co., New York. (Renominated.)

As directors-at-large: Jacob A. Keeth, manager of power production, Kansas State Power and Light Co., Kansas City, Kansas; Ralph A. Sherman, assistant director, Battelle Memorial Institute, Columbus, Ohio.

Natural Gas Pressure Used for Starting

An unusual method of starting gas turbines is mentioned in *The Brown Boveri Review* (Vol. 34, Nos. 6/7) in connection with the description of a gas turbine plant for Iran, containing two 4000-kw units designed to operate on natural gas.

Taking advantage of the pressure at which the natural gas is tapped (400 psi) electric starting motors have been dispensed with and in their stead expansion turbines are employed. These are of the impulse type, of simple construction with two rows of blading, and are so dimensioned that they suffice to accelerate the units to approximately 30 per cent of the normal running speed.

During the starting, until ignition takes place in the combustion chamber, the gas from the turbines is exhausted directly to atmosphere. The starting turbines re-

main permanently coupled and under normal operating conditions the natural gas is heated by means of the exhaust gases to approximately 570 F in the gas preheater and then expanded in the auxiliary turbines from 398 to around 65 psi abs. The output of about 150 kw thereby developed is transmitted to the shaft of the main unit.

Nuclear Engineering College Courses for Atomic Energy Employees

An unusual opportunity for employees of the Atomic Energy Commission's Hanford Works at Richland, Wash. to engage in college work is afforded by a cooperative arrangement just concluded with five nearby colleges and universities. Starting last year on the undergraduate level with two cooperating institutions, and some five hundred students enrolled, it has been extended at the graduate level to include five cooperating institutions, and more than seventy students are now signed up.

F. Ellis Johnson, formerly Dean of Engineering at the University of Wisconsin, has charge of the program for the General Electric Company, which operates the plant for the Commission. He announced that the University of Washington, Washington State College, the University of Oregon, Oregon State College and the University of Idaho have all agreed to cooperate by granting credits toward degrees for work done here.

The Hanford Works, the only plant devoted exclusively to the manufacture on an industrial scale of the nuclear fuel called plutonium, is operated by General Electric, under a contract with the Atomic Energy Commission.

The program of post-graduate study, just beginning, is referred to as the "Graduate School of Nuclear Engineering," and the five cooperating colleges and universities maintain similar relationships with the school.

Dean Johnson cited the following four major objectives in establishing the program of graduate study:

(*a*) Securing guidance and assistance by drawing from the experiences and practices of the country's educational institutions. Just as engineers need more fundamental scientific knowledge for their assignments at Hanford Works, so do the scientists need more fundamental engineering knowledge when they join that huge plutonium manufacturing activity.

(*b*) Stimulation of initiative on the part of employees of this vast new industry toward vital studies, and the giving of the rewards that are regularly accorded such effort.

(*c*) Elimination of any type of regimentation of cooperating institutions. Instead they are furnished every possible means of maintaining the standards which they, themselves, require of those to whom they grant degrees.

(*d*) Providing necessary information to cooperating institutions that will guide them both in their own expenditure of money and effort in research, and also in their choice of personnel to strengthen their staffs.

NEW CATALOGS AND BULLETINS

Any of these publications will be sent on request

Boiler Feed and Level Control

Two bulletins, Nos. 481 and 479, have just been issued by Northern Equipment Co., Erie, Pa. The former is devoted to a description of the Copes boiler-feed control at the Calco Chemical Div. of American Cyanamid Co. at Bound Brook, N. J.; and the second to the boiler water-level control at the Deferiet, N. Y., mill of St. Regis Paper Co.

Central Heating

"Pittsburgh's Great Institutions Join Forces for Central Heating" is the title of a brochure recently published by The Ric-wiL Company, Cleveland, Ohio. It is a detailed account of how a group of cultural, educational and medical institutions cooperated most effectively to achieve a practical central heating system covering an extensive area in the Oakland district of Pittsburgh. One of a series of case histories on central heating, the booklet traces the development of the Bellefield boiler plant from its origin in 1904, to serve the Carnegie Institute Museum, up to the present impressive system which serves many important and famous institutions and buildings.

Centrifugal Pumps

For the first time, De Laval Steam Turbine Company, Trenton, N. J., single-stage pumps have been included in a single comprehensive catalog No. 83-29, presenting features of design and construction, listing pump ratings and incorporating essential dimensions. With this catalog, engineers can select the required pump, estimate motor size and plan approximate installation dimensions.

In replacing several separate leaflets for these pumps, the one catalog now contains information for all G, I, K, L, M and P single-stage, single- and double-suction pumps. It also gives brief descriptions of such optional features as mechanical shaft seals, self-priming systems and vertical mountings.

Cooling Towers

Two new technical bulletins, Nos. 36 and 37, dealing, respectively, with spray-filled and wood-filled mechanical-draft cooling towers have been issued by the Binks Manufacturing Co., Chicago. The former is particularly adapted to cooling circulating water for refrigeration condensers and is built for capacities from 150 to 645 gpm. The latter type is offered in capacities ranging from 150 to 495 gpm.

Corrosion

A new booklet discussing various aspects of galvanic corrosion has been issued by The International Nickel Company New York. Prepared under the supervision of the Company's corrosion engineering section, it is designed for the production man as well as the research engineer. It not only covers some of the factors influencing galvanic corrosion but also presents data on how galvanic effects can be minimized.

Feedwater Heaters

"Spray-Tray Deaerating Feedwater Heaters" is the title of Bulletin N-16 issued by Elliott Co., Jeannette, Pa. The new design eliminates the customary vent condenser which is replaced by an inlet spray assembly and a simple vent-collecting hood. All parts of the heating section, except the non-ferrous inlet spray assembly, which is removable, are of stainless steel.

Flue Gas Analyzer

Davis Emergency Equipment Co., Newark, N. J., manufacturers of gas-detection, gas-analyzation and gas-alarm instruments, have just released a new four-page bulletin No. 1136A dealing with its latest development—the Davis Continuous Indicating and Recording Flue Gas Analyzer. It explains how this new unit analyzes the composition of the stack gases and indicates deviations from ideal combustion conditions.

Fluid Meter Data

Bailey Meter Company, Cleveland, Ohio, has issued revised Bulletin No. 301-B, entitled "Bailey Fluid Meters for Steam-Liquids-Gases."

This 40-page booklet is divided into ten different sections discussing, among other things, flow mechanisms, primary elements, integrators, auxiliary recorders, accessories, and installation features. Each section is illustrated by photographs and drawings of the equipment discussed as well as by diagrams which aid in understanding the operation. Also shown are representative chart records.

Fuel Oil Conditioning

E. F. Drew & Co., New York, has issued a 7-page illustrated technical bulletin entitled "Ameroid Fuel Oil Treatment and Sludge Remover" which deals with the five main problems encountered in the burning of industrial fuel oil. These are deposits of sludge in storage tanks; deposits in lines, strainers, preheater coils and burners; improper mixing of different batches or grades of oil; carbonization on nozzles and burner parts; and accumulations of coke and asphaltic materials in the furnace and on heating surfaces. The causes and corrective measures are discussed.

Ion-Exchange Materials

National Aluminate Corp., Chicago, announces a new booklet on ion-exchange principles, properties and uses; and technical data on materials. Section I contains diagrams, formulas and illustrations of basic ion-exchange reactions and typical uses. Section II gives technical data on each of the commercially available types of ion-exchange materials sold and serviced by Nalco; and Section III contains brief notes on a number of chemical manufacturing and processing operations employing ion exchangers.

Low-Level Eductor Condensers

An eight-page bulletin, 5-B, describes the Schutte & Koerting Company Low-Level Eductor Condensers which operate on the jet principle and eliminate the need for costly equipment. The only power-consuming auxiliary necessary for operation is a centrifugal pump for delivering injection water. Function drawings and photos are used throughout the bulletin to show the applications and operating characteristics of the equipment.

Oil Burners

Peabody Engineering Corp., New York, now has available two new bulletins on oil burning equipment. Bulletin No. 111 describes Type A and Type H oil burners with the wide-range mechanical atomizing feature, and Bulletin No. 205 describes the Peabody combination gas and oil burners. Both bulletins carry cross-section blueprint drawings of these types of burners and Types A and AB wide-range mechanical atomizers.

Valves

Heavy-duty steam valves are covered in a 28-page catalog issued by Schutte & Koerting, Philadelphia. Included are automatic non-return or stop-check valves, toggle valves, motor-operated non-return valves, stop valves, check valves, boiler-feed valves, streamline and automatic triple-duty valves. Materials employed for various parts of each of these heavy-duty valves are discussed and indicated on sketches, and dimensional tables are given.